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THE ARSENAL SHIP CONCEPT:
VULNERABILITES TO SPECIAL OPERATIONS

by

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The United States Navy has solicited proposals for a revolutionary class of ship, the Arsenal Ship. Despite reduced funding for the project, the concept is still viable for future development. We show how the development of a new unparalleled weapon system or platform will evoke a response by potential adversaries, based on capabilities and asset investment, by unconventional means. The Arsenal Ship is a formidable threat, yet is vulnerable relative to other high value units. These reasons make it an inviting target across the spectrum of conflict. This thesis will describe threats that are usually overlooked and examine the Arsenal Ship's vulnerability to them. In addition, we will show how these vulnerabilities arise as the Arsenal Ship operates through the range of geographic areas. Further, this thesis describes possible strategic and tactical defensive actions to enable the Arsenal Ship to counter these unconventional threats. Each recommended action has a direct implication upon the engineered design and the proposed Concept of Operations (CONOP). In addition, the recommendations will influence the strategy for employing any future platform based on the Arsenal Ship concept, anywhere in the world.

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ABSTRACT

The United States Navy has solicited proposals for a revolutionary class of ship, the Arsenal Ship. Despite reduced funding for the project, the concept is still viable for future development. We show how the development of a new unparalleled weapon system or platform will evoke a response by potential adversaries, based on capabilities and asset investment, by unconventional means. The Arsenal Ship is a formidable threat, yet is vulnerable relative to other high value units. These reasons make it an inviting target across the spectrum of conflict. This thesis will describe threats that are usually overlooked and examine the Arsenal Ship's vulnerability to them. In addition, we will show how these vulnerabilities arise as the Arsenal Ship operates through the range of geographic areas. Further, this thesis describes possible strategic and tactical defensive actions to enable the Arsenal Ship to counter these unconventional threats. Each recommended action has a direct implication upon the engineered design and the proposed Concept of Operations (CONOP). In addition, the recommendations will influence the strategy for employing any future platform based on the Arsenal Ship concept, anywhere in the world.

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I. INTRODUCTION

For any new and innovative weapon system or platform, the question of capabilities versus vulnerabilities are always at the forefront of discussion. This thesis will address critical vulnerabilities to special operations targeting that the Arsenal Ship concept and development has left unattended. Chapter II will define the proposed "concept of operations" (CONOPS) and physical design considerations of the Arsenal Ship (ARSHIP). This will then lead into the proposed role that the ARSHIP will hold in American foreign policy. Chapter II also defines the terminology of "special operations", as it will be used academically in our thesis. That chapter will also introduce the reader to the military and political utility of special operations. This will evolve into a discussion of why states would conduct special operations in lieu of, or to augment general-purpose forces. This will illustrate the attractiveness of the ARSHIP as a target for special operations.

Chapter III will categorize the outcomes that potential threats might attempt to achieve. These categories, coupled with the dissimilar geographic areas where the ARSHIP faces different defense challenges, will

be used to show the potential threats that the ARSHIP will face. From this, a comprehensive list of possible courses of action that can threaten the ARSHIP will be compiled. After a brief description of each attack mode, factors that affect the defense of the ARSHIP will be discussed. This will lay the groundwork to demonstrate how special operations can effectively circumvent traditional defensive measures and achieve the previously described mission objectives.

Chapter IV will be an in-depth analysis of five special operations courses-of-action that are, in the case of the ARSHIP, more predominant and highly potent. The in-depth analysis will describe the characteristics of ingress/egress and actions at the objective. These will be described as modes of action and objectives of action. Chapter IV will further discuss the mitigating factors that affect the effectiveness of the aggressor and the defense of the ARSHIP. By understanding the interplay between the two, defense options will be formulated.

Chapter V will address possible strategic and tactical defense options that should be implemented for the ARSHIP. The defense options are formulated with unconventional threats in mind, but their value against conventional attacks should not be discounted. Most of the strategic

measures are to dissuade an adversary from conducting an unconventional attack through deterrence and deception. The proposed defense options will have an effect on the engineering design, the proposed CONOPS, and the strategy utilized in the future employment of the ARSHIP concept.

This thesis was initiated prior to the formal decrease in funding of the ARSHIP concept. Its initial intent was to become an integral part of the iterative process of refining the ARSHIP's CONOPS and physical design. We have continued its pursuit based on the importance of educating future planners and designers who might propose similar concepts of a large, highly automated and low manned warship.

II. THE ARSHIP AND SPECIAL OPERATIONS

A. THE ARSENAL SHIP

The ARSHIP is a proposed U.S. naval warship that can be loaded with 500 missiles in a vertical launch system (VLS). The payload of missiles can be a combination of cruise and/or anti-air missiles. They will be able to receive targeting data and launched either from onboard the ARSHIP or remotely from another platform. The missiles will be used for theater missile defense (TMD), anti-air warfare (AAW), and deep strike operations. Ideally, the mission of the ARSHIP concept is for the vessel to be positioned within its weapons' range to an adversary and act as a tool for U.S. coercive diplomacy.

The ARSHIP will be a technologically advanced ship, designed to operate with a reduced crew of less than 50. The vessel's size will be approximately the length of two football fields and have a sustained maximum speed of 22 knots. Full automation and redundant networking will eliminate system failures with every system onboard. The command and control system will be fully integrated and utilize the most advanced technology available. Even damage control (DC) sensors and actions will be automated.

Proposed CONOPS scenarios have the ARSHIP out to sea for extended periods of time and it will either deploy as a stand-alone platform or be accompanied by a conventional surface combatant. To operate alone, the ARSHIP will rely on its stealth design for concealment. It will not be equipped with self-defense weapons systems. Along with its low visual profile, the technological features of its stealth design will reduce its electromagnetic and acoustical transmissions. Defense of the ARSHIP depends on the success of these technological advances to conceal its location and allow it to operate freely under this cloak of invisibility. Another CONOPS proposal is to have an unmanned version of the ARSHIP controlled by electronic tether from another ship operating within line of sight (LOS).

B. UNDERSTANDING THE ARSHIP'S ROLE

The ARSHIP will, herein, be described on two levels. First as a weapons platform, that is deployable and moves the system of weapons from geographic region to region. Secondly as a weapon system that fires missiles, commanded either remotely or locally, projecting power ashore. The ARSHIP can be likened to a ballistic missile submarine, a weapon system by design as well as a deployable platform. This distinction will lead to the understanding that this

new ship is an important *new target*, different in critical ways from other surface combatants. This will increase the range and importance of threats that the ARSHIP will encounter.

The ARSHIP will be capable of delivering an unparalleled level of distant precise destruction. This potential destruction is a step change in current capabilities which is unrivaled by its conventional peers. Some refer to it as a capital ship while others view it merely as a floating ammunition barge. Regardless of the proponents'/opponents' views, the bottom line is that it will have unparalleled influences on U.S. foreign policy because it is a means for exacting unsurpassed tolls on an enemy's infrastructure and military capability. This places many of the U.S.' conventional competitors at a disadvantage and position of asymmetrical weakness. Consequently, this new ship warrants an opponent's heightened attention across the spectrum of conflict.

C. DEFINITION OF SPECIAL OPERATIONS

Scholars have debated the definition of special operations, developing definitions that primarily assist their own theories. The common denominators of many of these definitions boil down to three basic characteristics. Special operations are militaristic operations that are:

1) small in scale; 2) planned to have the effect of high leverage; and 3) unorthodox.[1] The usefulness of this definition is in its universal applicability beyond the narrow paradigm of Western thought.

Each characteristic must be present to distinguish a militaristic operation as a special operation in the context of war and politics. The first condition, small in scale, separates a special operation from an unconventional operation carried out in the conduct of maneuver warfare, such as an airborne assault, or amphibious landing. The second condition is that the operation is designed and has the potential to impose an effect much larger than its investment. Inherent in the condition of high leverage is that this effect is a product of planning and not of happenstance. Finally, no special operation would be "special" if it wasn't different from the main stream of tactics in the context of the conflict. Ergo, a special operation must be unorthodox.

Who conducts special operations? In an attempt to enlighten the reader to special operations, a comprehensive list of potential actors that are available to any group, organization, or state to conduct a special operation has

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[1] Arquilla, John, Editor, From *Troy to Entebbe: Special Operations in Ancient and Modern Times*, University Press of America, Inc., 1996.

been established. First, there are elite state-sponsored military units that are highly trained in conducting small unit tactics that fill a void that general-purpose forces cannot. Secondly, trained militia and mercenary groups that are for hire throughout the world are recognized. These mercenaries are, in their own way, elite units based on special training and recruitment. Thirdly, organized crime and terrorist organizations that may be solicited or coerced into working on behalf of a group or state are prime candidates for conducting special operations. Fourth, is the inclusion of any civilian who is a resource and can be commissioned or politicized to organize or act in proxy for a state in the conduct of special operations. Lastly, is the admission that general-purpose forces, when utilized in a definitive manner can also execute special operations. This chapter will conclude with the answer to *why* a power would conduct a special operation.

D. COMPARATIVE ADVANTAGES OF SPECIAL OPERATIONS

In the decision to conduct a special operation, a question arises: To what extent do external and internal constraints and opportunities shape the relative advantages of conducting special operations in lieu of conventional operations. To attempt to understand the decision-making process between the two, we propose the use of two concepts

of utility, simple cost-benefit analysis and our concept of singularity. Singularity occurs when there is only one option available or capable of achieving a specific goal.

Utility theory is an intricate weighing of costs and benefits in the context of the decision-maker's philosophy as well as relative resource levels. Context plays a key role in all levels of this method of analysis. Each level is dependent on current capabilities and resource levels. Utility theory is applicable in the concept of military and political decision-making and operational selection. These two concepts are deliberately and subconsciously utilized when making decisions. Cost-benefit analysis can be carried out on many levels: politically, socially, militarily, and economically.

The first level of operation selection is the military level of cost-benefit analysis. The key resources of any military are funding, personnel, high value assets, and equipment. On the cost-benefit scale of personnel investment, a special operation tilts the balance in its favor over conventional applications of force. This pertains to the size of the operation and the advantage of investing small numbers to achieve large effects. Considering the investment of high value assets such as aircraft, ships, or submarines in support of a special

operation is also an important issue. This is where much of the potential deliberation is carried out. The threat of loosing a high value asset in order to carry out a small operation is measured against the expected outcome. For example, due to the number of helicopters that the U.S. had in inventory, the investment of helicopters in Desert One was a minimal factor based on the mission's possible success or failure. On the other hand, placing a SSN/SSBN into harms way in order to insert a special operation force could be seen as a risk not worth the best outcome.

The second level of operational selection via cost-benefit analysis is the political level. There are two identifiable constraints faced by a state or organization at this level, internal and external. Internal constraints apply to a state's constituency's responses to executing a special operation. The methods of execution, the expected and resultant outcomes, and the appropriateness of the operation are key perceptions that are analyzed by these audiences. External measures apply to the international response to special operations. These two measures are political and social in nature. This is to say that although a state may utilize a special operation to achieve a political goal, the world population has a voice beyond simple representative politics. This voice can be heard

through product boycotts, demonstrations, and direct terrorist actions. Political ramifications, intended and unintended, take many forms ranging from political isolation in the international community to military action by coalition governments. These measures illustrate the highest gains and losses that a state can achieve or suffer in the arena of international relations.

The third level of analysis is the economic level. This takes into account the cost and availability of assets, rather than the operational and strategic value of assets. Economics can decide how much of an investment a group or state is willing to put into equipping a standing army with armored vehicles, tanks, aircraft, and large ships. Special operations forces require only a small percentage of the funding needed for a standing army. However, the bottom line with regard to economics is still the military effectiveness of the armed forces that a state is willing to build and sustain.

Singularity is distinguished by the uniqueness of an operation relative to other available means. Levels of uniqueness are based on the congruence between internal and external constraints and the ability of the forces to conduct the mission within those boundaries. The

employer's specifications or the situation's demands are seemingly less tangible. These characteristics of uniqueness qualify an operation as a singular option when it is the only available method of high precision, surprise, speed, relative size, survivability, non-attribution, or success. The ability of a force to "fit" such a tightly constrained operation is characteristic of special operations.

Constraints can be categorized as internal or external. Internally, there are "rules of engagement" (ROE), "commander's intent" along with "specified and implied tasks" that dictate the uniqueness of forces and operational method selected. For example, a power may want to abduct a high-ranking official without causing any large-scale damage, without occupying terrain, all within a specific time period. There is little cost-benefit analysis applied in this decision process, especially in those states or organizations that have standing trained special operations forces. The specified uniqueness called for in this case results in only one option for strategic personnel extraction, a small covert force.

Externally, the defense posture of the opponent, the weather, the terrain, and the timeliness or urgency of an operation can dictate the necessary uniqueness of the

operations selected. For example, an opponent that is heavily fortified may let down his guard in the perception of friendly or neutral activity in the area. This would apply well in commercial fishing areas where navies and coastal patrols are active. A special operation may utilize commercial or leisure craft to navigate undetected in plain sight to execute their mission. Further examples can be extended to those trained forces that are comfortable operating in challenging weather elements. Darkness, fog, wind, and high sea states may be deemed too dangerous for operations to be conducted by general-purpose forces. There are external constraints that allow a force or course of action to be the only possible choice. Some of these include the probability of surprise, success, and survivability.

These characteristics of singularity are more pronounced at the higher levels of operational and strategic force employment. This is apparent due to the high leverage that can be brought to bear by a special operation. Additionally, singularity establishes a niche for special operations in the most politicized form of warfare, the use of special force in executing foreign policy. This is considered the highest form of strategic utility.

Applying this chapter's methodology for classification and understanding the utility of operations, will assist in understanding the objectives, and therefore the ways and means of conducting special operations against the U.S.' new attempt at high technology, the ARSHIP.

III. POTENTIAL THREATS FACING THE ARSHIP

Having established the ARSHIP's position as an instrument of United States foreign policy and using defined terminology and methodology as points of departure, this chapter describes potential courses of action that the enemy can use to counter the ARSHIP.

The first section in this chapter proposes that there are five distinct categories of aggressive objectives that would mitigate the effectiveness of the ARSHIP. These objectives will define which courses of action the adversary may take against the ARSHIP. Resultant is a comprehensive list of these courses of action. This chapter then briefly reviews their objectives and potential for employment and success. This comprehensive list will be reduced in Chapter V to only include courses of action that are special operations and the shortened list will be examined in detail. Concluding the chapter is a discussion of mitigating factors that assist or hamper the success of the special operation being conducted. Chapter V will also utilize these factors to critically review the shortened list of courses of action and the defensive ability of the ARSHIP.

A. ENDS OF THE THREATS

Objectives of combating the effectiveness of the ARSHIP are categorized into five possible categories. These five objective assist in defining the possible courses of action (COA) that a state or group may take against the ARSHIP. They are:

1. Kill the ARSHIP
2. Control or displace its geo-location beyond its weapons' range
3. Reduce the rate of fire
4. Reduce the probability of hit
5. Reduce the effect of hits

The first category, kill the ARSHIP, is self-explanatory. It means the *permanent* effect of sinking the ship or destroying critical components of the ARSHIP's structure that cannot be shored up or replaced. There are no variable intensities of this objective category. Terms such as 'soft kill' will not apply to this category. Effects such as temporarily effecting maneuver and firing will fall under other categories.

The second category, control or displace the ARSHIP's geo-location beyond its weapons' range, is a temporary effect that can be broken into gradations of success based

on the attacker's conflict requirements. This category includes a wide variety of actions. Possible COA include:

1. Piracy, seizure, and hostage

2. In-port attack on critical nodes
    a. Propulsion
    b. Weapons loading
    c. Manning
    d. Structural damage

3. At sea:
    a. Threat based maneuver
    b. Propulsion damage
    c. Structural damage

The third category, reduce the rate of fire of the ARSHIP's missiles, is again one with degrees of effectiveness. Reducing the rate of fire can be described as reducing to a zero rate of fire, simply reducing the rate below a certain threshold, or reducing the rate from the ominous possibility of near simultaneous launch of 500 missiles at different targets. Potential methods of achieving these goals include but are not limited to:

1. Distraction: To harass the crew or defense escorts forcing
    a. maneuver rather than fire control
    b. damage control rather than fire control
    c. defense rather than fire control
2. Disruption: To act to disrupt the fire control system that is dependent on automation

a. disrupt its external communications

b. disrupt its internal fire control

c. disrupt its use of mechanical VLS

The last set of disruption points identifies critical nodes rather than courses of action.

To achieve a reduced probability of hit, an adversary can effect the ARSHIP or the potential target set. Doing this, the adversary can take preventative, preemptive or reactive measures. Actions the adversary can take regarding the potential target set includes but is not limited to:

1. making critical nodes mobile
2. utilizing camouflage to conceal their position from overhead sensors
3. utilizing false targets to draw fire from real targets

Actions an adversary can take proactively toward the ARSHIP to attempt to effect the probability of a hit include but are not limited to:

1. disrupting targeting communications data stream
2. replace the targeting communications data stream
3. taking control of onboard guidance systems

Reducing the effectiveness of the hit of a missile is purely a preventive measure. This would include target hardening with concrete, tunnels, and bunkers.

B. MEANS OF POSING A THREAT

1. Medium Considerations

An adversary can attack a target through one or a combination of five mediums, air, land, sea, space, and the electromagnetic spectrum. Air, land and sea are the main mediums in which these actors can attempt to operate directly against the ARSHIP. The categories of space and the electromagnetic spectrum indirectly affect the ARSHIP, mostly in the realm of sensors and communications.

2. Methods of Approach

Each of the three primary mediums (air, sea, and land) can be used for direct physical attack. Attacks in a number of different ways including sub-surface, maritime and terrestrial surfaces, and air attacks. Sub-surface attacks are delivered from below the surface of the water. This makes visual and electronic detection and defense more challenging. Electronic detection depends on environmental conditions and capability of the equipment and individuals manning it. Without a means to visually detect the underwater threat; such as air bubbles, water turbulence, or any other factor associated with the attackers'

movement; their approach will proceed without warning and catch the vessel by surprise and unprepared to defend the attack.

Maritime surface threats may be easier than sub-surface threats to detect, but they are serious enough to raise concern. The surface contact must be detected and assessed before it is perceived as a hostile threat. A small fishing vessel may be perceived as innocently proceeding about its job when its true intention is to close on the ARSHIP and attack it. The ability to discern between innocent and aggressive movement requires personal and professional judgment before reporting it. This delay in reporting gives the attackers additional time to accomplish their desired intention.

Electronically, discrimination between land and threatening contacts on land is nearly impossible for a maritime vessel. Visual detection of a threat is limited to the range and bearing of vision from an individual's vantage point. Land areas located near waterway and around harbors are usually highly populated. Clutter associated with urbanization, such as buildings and vehicles, can be advantageous to an attacker. Projectiles can be launched from land units as well as an assault force, when the ship is tied to a pier.

Air attacks are not limited to certain lanes of approach. An air attack can come from any direction. This requires 360-degree, 3-dimensional surveillance for detection. Another advantage is that higher speeds can be achieved during an approach than in the other types of attacks. Lower speed approach can also be an advantage to the attacker. Physically, they can fly below the detection equipment's operating azimuth caused by the earth's curvature. Additionally, the equipment may not classify a contact as hostile when aircraft approach below the automated parameters of the search system. Much like the threat of falsely perceived innocence of maritime surface threats, aircraft can proceed along established commercial air corridors then diverting quickly to threaten the ARSHIP.

3. Geographic Considerations

By choosing which outcome best fits their strategy, the adversary will choose the best time and place for their attack. The tactics which potential adversaries will utilize to pursue the ARSHIP will be guided by its location. Any ship has vulnerabilities whether *inport* or at sea. However, the ARSHIP's reduced crew size, CONOPS and streamlined topside are factors that make it more vulnerable than most other surface combatants. Therefore,

our analysis of the ARSHIP will be shaped according to the geographic areas of vulnerability, categorized as *inport*, *open ocean*, and *confined water*.

Inport is the area located along a waterway or harbor near a land facility where the vessel is tied to a pier or anchored in the harbor. Factors associated with a vessel *inport* are its positioning and defense posture. At anchor or pierside, the vessel is relatively stationary and cannot get underway without proper engineering preparation. Without prior threat warning, the vessel's defense posture is usually at a lower state than if at sea or operating in the vicinity of known threats. For example, a ship *inport* does not have the necessary equipment operating to detect attack and must rely on sailors working and posted about the deck to observe threatening intentions from an adversary. *Inport* protection and readiness are usually less than when underway.

Open ocean is the operation area that is devoid of land, shallow water, miscellaneous high volume shipping traffic, and other types of hazards to navigation. In *open ocean*, a vessel can maneuver freely and unimpeded. In addition, the crewmembers are active and the defense posture is higher. All vital equipment is properly manned and operating.

Confined water is an area where a vessel is restricted in its ability to maneuver while transiting or operating in the vicinity of littoral waters in which there is "clutter." Clutter is the presence of other vessels, land, shallow water, oil rigs, air traffic, electromagnetic traffic, and other obstacles that become too numerous to track. In *confined water*, the ability to discern friendly from hostile contacts is challenged. The defense posture is higher compared to *inport*, but some radiating equipment may not be allowed to operate due to the close proximity to land. Additionally, individuals that normally man detection sensors may be conducting other duties such as "sea and anchor detail."

C. INITIAL LIST OF POSSIBLE THREATS

Having already addressed where and how a threat will be used, our thesis will now develop a comprehensive list of possible threats. A warship is the weapon platform that carries the weapon system, such as a missile system. The missile system includes all associated tracking and firing equipment as well as the weapon, the missile itself. The missile is used to directly destroy the target.

The threats to the ARSHIP are limited only to the adversaries' imagination and ability to carry them out. Table 1 illustrates our list of the entire spectrum of

possible threats. These potential threats are grouped according to their means of attack. The geographic areas of vulnerability are used to discern which threats are capable of operating against the ARSHIP in that arena.

	INPORT	*OPEN OCEAN*	*CONFINED WATER*
Sub-surface			
Submarine		X	X
Mini-Sub	X		
Manned Torpedo	X	A	A
Mines	X		X
Sub-surface/Surface(M)			
Combat swimmer	X	A	A
Surface (Maritime)			
Small Boats			
Recreational/Leisure	X		X
Combat Raiding Craft	X	A	X
Other Small Craft	X	A	X
Surface (Both Maritime and Terrestrial)			
Assault Force	X	A	A
Gunfire	X	A	X
Air			
Helicopter	X	A	X
Planes			
Ultralite	X	A	X
Glider	X	A	X
RPV	X	A	X
Private/Commercial	X	X	X
Parachute	X		
Missile Attack	X	A	X

X = no assistance from additional weapon platform required.
A = assistance from additional weapon platform (aircraft or larger vessel) required.

Table 1. Comprehensive Listing of Threats to the ARSHIP

1. Submarine

Submarines, due to their size and maneuvering constraints, are assets that are restricted to movements in more open and deeper waters. Their undetected approach is impossible in all but deep-water ports and is, therefore, suited to *open ocean* or *confined water* attacks. As a weapon system, the submarine can directly attack the ARSHIP by using torpedoes, the goal being to sink the vessel or render it unable to maneuver and/or perform its mission. In *confined water*, the submarine's ability to discriminate between the ARSHIP and surrounding contacts is a problem it must overcome. The submarine can be used as a weapon platform for other types of attack. Combat swimmers and small inflatable boats can be "locked out" of a submarine at depth or deployed while on the surface. The submarine then is an ingress/egress platform for these courses of action.

2. Mini-Sub

A form of submarine that is suited for *inport* attack is the mini-sub. This smaller version can operate in shallow water, approach a target virtually undetected, and severely damage a target.

Similar to the submarine, the mini-sub is operated by highly trained personnel and therefore, is limited in its

use by States that have the necessary resources. The U.S. Navy SEALs operate a mini sub, the Swimmer Deliver Vehicle (SDV), as do the countries such as Britain, Bahrain, and most notably North Korea. Recent press releases have demonstrated the North Korean's willingness to use the mini-sub for ingress into South Korea.

3. Manned Torpedo

Like the mini-sub, a manned torpedo can operate *inport,* and *confined water.* As a weapon, the manned torpedo is similar to a conventional torpedo with the exception that guidance requires a human pilot to align it with the target. The pilot can either eject or ride it until contact with the target and detonation. Many terrorist groups are more than willing to undertake a suicide mission in order to achieve a desired goal. The pilots of the manned torpedo must be properly trained in the skills required to breathe compressed air and to navigate underwater. This will eliminate many smaller, unsophisticated countries and organizations.

4. Mines

Any country or organization can procure and deploy a mine. Mines can float on or below the surface or dwell on the bottom. Sub-surface mines are virtually visually undetectable. Most mines do not have guidance systems to

direct them to a desired target. However, smart mines can detonate on certain specific gravities of metal hulls, on certain acoustical signatures, on a specific number of repetitions of either occurrence, and upon command. A general-purpose mine must rely on physical contact to trigger detonation. Neither general-purpose mines nor smart mines are precision strike weapons unless they are in the vicinity of a desired target and command detonated.

5. Combat Swimmer

A sub-surface or surface threat of a combat swimmer can range from a single swimmer to a group working together as a team. The ARSHIP must be immobile to conduct such an operation due to the fact that the maximum speed of swimmer is 2 knots. To function as a weapon, the combat swimmer can attempt to strap explosive to his body and conduct a suicide mission against the ARSHIP. As a weapon system, the swimmer or team's goal can be to attach an explosive charge to the ship's submerged structures or climb aboard. A team has a better chance of neutralizing the crew in order to control the vessel and its payload.

The process of swimming or diving may also be used as ingress/egress methods to reach land or another vessel before conducting an attack. In addition, the adversary approaching on the surface is easier to detect than if

submerged. The Viet Cong demonstrated the ability to conduct combat swimmer operations in the Mekong Delta during the Vietnam War. Examples of current elite units are the U.S. Navy SEAL units and the German Kampfswimmers.

6. Small Boats

Boat attacks can be from commercial boats, recreational/leisure craft, combat raiding craft, and other small craft. These types of boats are relatively inexpensive, need little training to operate, and are common throughout the world. Any group or organization whether state sponsored or acting independently can use small boats. A boat can act as a weapon by being loaded with explosives and ram the ARSHIP. A suicide mission like this can be effective and most likely used *inport* or in *confined water*.

A small boat can appear innocent and approach very close to a vessel without raising alarm. This ability can be used not only to conceal its deployment as a weapon, but assist it as a weapon system and platform. In the role of a weapon system, a small boat will likely carry armament that will be used to directly attack the ARSHIP. As a weapon platform, a small boat can deliver an assault force to the ARSHIP or insert combat swimmers in the vicinity of their target.

7. Assault Force

An assault is when the adversary attacks the ARSHIP with intentions of boarding. Their access can be gained via land, sea, or air. The force can be stationed on land or they can reach it from the sea or air by utilizing a delivery platform. To exploit the option of a land assault, the ARSHIP must be *inport* and tied to a pier. The terrestrial assaulting force can get onboard by way of the brow, mooring lines, ladders or leap onboard. In *open ocean* or *confined water*, an ingress method must be used to deliver an assault team to the vessel.

Once they have successfully gained access, they can perform their desired mission. If used as a weapon, the assault may take the form of a suicide bomber that has explosives attached to their body. The assault force, acting as a weapon system, can also place explosive charges in specific locations to damage or destroy vital equipment. The force's objective may be the crew. By controlling or eliminating the crew, the assault force gains command over the vessel and its payload.

The assaulting force's training required depends on the mission and the desired result. Any untrained individual can conduct a suicide bombing. An intricate plan to access the ARSHIP and place explosives on vital

equipment or neutralize the crew requires a highly trained force. The training must focus on coordination and knowledge of the target. Many possible methods of ingress may require additional specific training against the ARSHIP's characteristics. The assault force tactic by its complex nature may require elite forces to ensure some degree of success. Recalling *who conducts special operations*, these forces are; elite military units, trained mercenaries, or organized pirate groups (criminal).

8. Gunfire

Gunfire can come from artillery and other larger caliber weapons positioned on land or from a weapon platform at sea. Gunfire requires targeting information for accuracy. It can have a range from hundreds of yards to several miles depending on the caliber and design. The gunfire can be used to destroy equipment and render the vessel unable to conduct intended missions. Many states and organizations possess the ability to procure and fire large caliber weapons. Therefore, the use of gunfire is a threat option that can be used by any adversary.

9. Aircraft

There are a number of different types of aircraft that can pose threats to the ARSHIP including helicopters, airplanes, ultralites, RPVs, and gliders. A helicopter, by

flying low and slow, can go undetected by automated electronic sensors. Once close to target, a helicopter loaded with explosives can be a weapon used to impact into the target. As a weapon system, the helicopter can attack the ARSHIP's topside equipment with guns or missiles. It can also be used as an ingress and egress platform to deliver combat swimmers, small boats and personnel into the water within range of the ARSHIP, or an assault force to the deck of the target in order to accomplish the adversary's goal.

The operating range and speed of an airplane makes it a threat to the ARSHIP across all geographic areas. However, smaller types of planes need to operate closer to land. Loaded with explosives, the aircraft can become a guided warhead. Private or commercial planes may seem unthreatening if operating along normal air traffic patterns. Therefore, their ability to not draw attention as a threat can be used to approach the target.

The airplane may also perform as a weapon system. A plane can be used to drop bombs or launch missiles. For ingress, the airplane, as a weapon platform can deliver an assault force. The cost and skill required to procure and train pilots depend on the type of aircraft being used. An ultralite, glider, or RPV require little, while a

helicopters and private or commercial airplanes need more training and funding to maintain and operate. These factors make it likely that any organization or state can utilize an air threat.

10. Parachute

Utilizing the helicopter or airplane as a platform, parachute operations can be used only as an ingress method. The parachute can deliver an assault force to the land, water, or directly on the vessel. Due to the difficulty associated with attempting to land a parachutist on a moving target, parachute operations require a nearly stationary platform, limiting the parachute assaults to only when the ARSHIP is *inport*. In addition, the parachute can be used to deliver boats into the vicinity of the target to attack a vessel operating at long ranges from land. Once onboard the team operates as if delivered from any one of the other mentioned delivery methods. To conduct such an operation, minimal training is required. Parachute training is available from any source and does not need to take place in a formal military environment.

11. Missile Attack

Launched from a weapon platform or launched from a land site, a missile attack utilizes the assistance of a rocket or turbofan motor as a means to deliver a

destructive warhead to the target. Missile range determines the need for a weapon platform to approach within its range in order to be effective. As a weapon, the missile can have internal targeting and navigational systems or it may require external inputs for terminal guidance. Either method relies on the ability of the adversary to properly target the ARSHIP in order to assure a direct hit. Like guided bombs, missiles would rely on a guidance system for terminal guidance. A missile's radar would be defeated by the ARSHIP's stealth qualities. A sophisticated and advanced missile is expensive to obtain and like all high priority intelligence keys, will be tracked at higher government levels. Another possible missile threat is a hand held missile system and intelligence sources are important in providing possible warnings of their procurement and use by non-state groups and organizations. Other types of projectiles, which are harder to track, are rocket propelled grenades (RPG) and recoilless rifles, which could be considered as a missile threat when, launched from a proximate platform.

D. MITIGATING FACTORS

1. Aggressor's Personnel and Equipment

There are mitigating factors that affect the defense of the ARSHIP to these threats. They are the limitations

of an aggressor's personnel and equipment, the environment, and the constraints of a defensive posture for the target vessel.

Physical limitations of the aggressive personnel and the equipment employed characterize the one mitigating factor category. Personnel considerations are considered mortal in nature. They depend on physical conditioning, physical exposure to the elements and hazards to life. To execute an attack, the individuals assigned the task must have the ability to successfully complete it. The physical demands of swimming, diving, boating, packing or running extended distances require physically fit individuals. As seen with a combat swimmer or air threat, the proper equipment is required along with associated training to operate it. The equipment may be expensive, possess advanced technology. The ability of an adversary to possess, maintain, and operate some types of equipment may not feasibly be within their means. The equipment alone will not make an attack succeed, but its utilization by a properly trained individual make it an asset.

2. Environment

The next factor associated with a threat's effectiveness is the environment. Environmental considerations include illumination, weather, and medium

characteristics. Elite units train in harsh conditions so as not to be limited by their constraints. However, there are still environmental properties that will always adversely effect humans and equipment.

With respect to illumination, the time of day or night has an influence on the threat's ability to succeed undetected. Additionally, during the day, crewmembers on the intended target are more likely to be alert and responsive to multiple threats. Darkness can completely conceal the approach of an adversary or severely impair the target's ability to detect several threats. The adversary's ability to operate without the aid of illumination also requires coordination, training, and additional equipment such as night vision devices. The ability to attack at night falls into the realm of special military elite units but does not exclude others from operating in it.

Weather includes visibility issues, sea state, and high winds. The factors affiliated with weather affect both the attacker and target. For every positive effect associated with it, weather has a counter effect that may provide addition obstacles to overcome. Visibility is diminished with the addition of precipitation such as rain, fog, or snow. Precipitation can degrade the ARSHIP's use

of radar, visual sightings, and other forms of detection for defense. While it conceals their approach, the attacker must be able to discriminate between the target and other unimportant contacts in order to succeed.

In addition to precipitation, sea state is adversely affected by bad weather. A higher sea state makes tasks such as small boat employment and surface combat swimmer more laborious and difficult. The sea state can also assist the stealth technology of the ARSHIP, by providing more 'noise' to passive and active electronic sensors. High winds increase sea state, but are not necessary to produce higher sea states. Additionally, higher wind speed can oppose the adversary's use of small aircraft and the parachute. An ultralite, glider, or RPV also, may not be able to operate under these circumstances.

The characteristics of the medium in which the attacker must transit to reach the target are ambient temperature, and ecological activity. Cold temperature can adversely affect an individual when exposed for prolonged periods. Hypothermia in cold water and frostbite in cold air are results of extended exposure. In addition, cold temperature can dull the senses and delay reaction time. Protection from extreme weather is required for anyone wanting to operate under these conditions. Bioluminescence

can expose the approach of a submerged combat swimmer, mini-sub, or small boat and alert the target. Wildlife may use the approaching medium as a habitat area and their disturbance can result in a commotion that the target can detect. An example would be an assault force approaching over land that startles a flock of birds on the ground, announcing their presence.

3. Constraints of a Defensive Posture

The defensive posture of the ARSHIP will greatly affect the likelihood of a successful attack. Defensive posture is characterized by the readiness of the crew and vessel, the current position, speed of advance and assigned tasks.

The speed of advance for the ARSHIP eliminates those assaults that require a nearly stationary target or one that travels at relatively low speed, 5 knots or slower. The higher the target's speed, the harder it is to gain access to the vessel while underway. In this respect, the vessel's speed can be used as a form of self-defense.

The ARSHIP's position also dictates the type of attack that can and cannot be made. Furthermore, its position in *open ocean* will allow it to be more defensible as well as reducing the likelihood of less robust threats. *Inport* and

in *confined waters* inherently reduces the maneuverability of the ARSHIP, making it a sitting duck.

The state of readiness of the vessel and crew can be key factors for success. Readiness is a factor that is based on the perceived likelihood of direct confrontation against an adversary. The level of readiness increases as the political, strategic and tactical situation with an adversary moves across the spectrum of conflict from peace to war (graphically left to right, Figure 1.). On the farthest left side of the spectrum is peace followed by Military Operations Other Than War (MOOTW). MOOTW consists of Humanitarian Aid (HA), Non-combatant Evacuation Operations (NEO), and any other similar type of operations conducted by the U.S. military throughout the world. The next stages of the spectrum refer to Deterrence, Defense, and Compellance (War) in that order. War consists of Lesser Regional Conflicts (LRC) and Major Regional Conflicts (MRC).

Along with the escalation of the level of conflict, the proximate range from the perceived threat further influences the readiness of the crew and vessel. The level of readiness will increase as they approach weapons' ranges of an adversary. In Figure 1, the top graph shows how the level of readiness fluctuates along the spectrum of

conflict. The bottom two graphs show the difference in readiness according to the range from the threat. The farther away from the perceived threat a vessel is, the lower its readiness level will be relative when it is closer to the threat. This difference will continue until a point is reached along the conflict spectrum when attack is possible anywhere and at any time.

For the two readiness curves to meet, an adversary must have the ability to launch attacks that can reach U.S. assets globally. This state of higher readiness cannot be sustained for prolonged periods and will wane over time. Therefore, as it ebbs, the heightened state of readiness is no longer a factor in the vessel's favor and becomes a vulnerability. The crew can become desensitized to constant warnings and authentic cues of an actual attack may not be heeded.

Any advantage associated with readiness is in the attacker's favor, because he decides when, where, and how he will attack. The target's state of alert can be heightened if warning is given in advance. The readiness level is also dependent on the ARSHIP's geographic position. As shown in Figure 2, the readiness curves differ for *inport*, *open ocean*, and *confined water* operation.

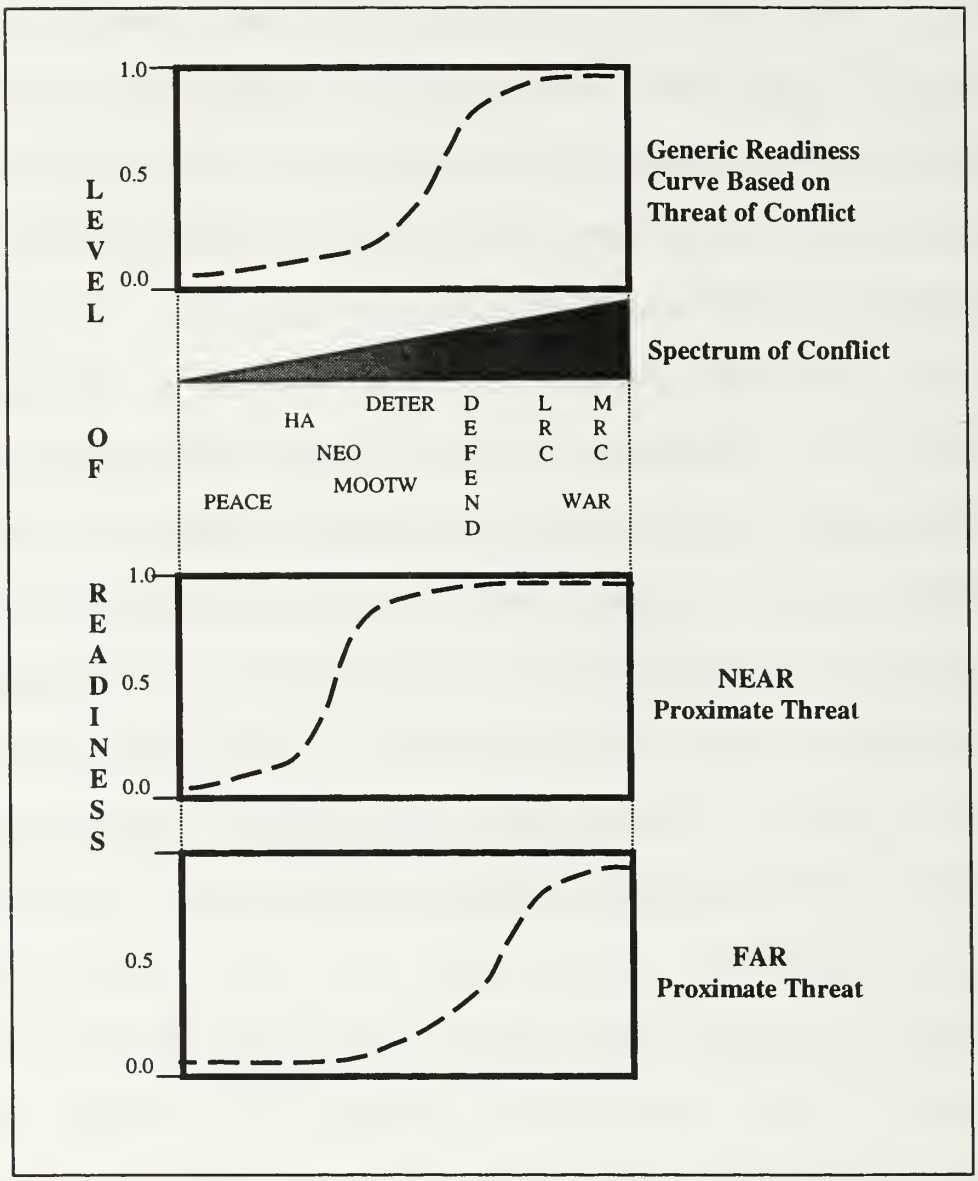

Figure 1. Readiness Curve Across the Spectrum of Conflict and Proximate Distance to Threat

Inport the preoccupation of the crew to perform routine maintenance or repair equipment along with the crew's liberty ashore moves the curve to the right.

This decreased readiness compared to the other geographic areas affords a window of opportunity for an adversary. Operating in *open ocean*, the crew is aware of their surroundings as far as the equipment can detect. Equipment is operating and manned, and the crew is focused on the tasks at hand. Levels of readiness are further shifted to the left when operating in *confined water*. Our definition of *confined water* explains this shift. The need to monitor the surroundings for maneuvering places the crew at a higher readiness level than other geographic areas. An adversary who understands the subtle shift of readiness among the geographic areas can use it as an advantage to plan and execute an attack.

Like the crew, the ARSHIP itself must be at a high state of readiness. The limits associated with the equipment affect the ability of the ARSHIP to respond to possible threats. Without special search radar, a threat built of composite material may not display a radar signature and the low speed of the threat may allow the equipment to disregard it. Therefore, the system may not recognize nor display the threat to the operator.

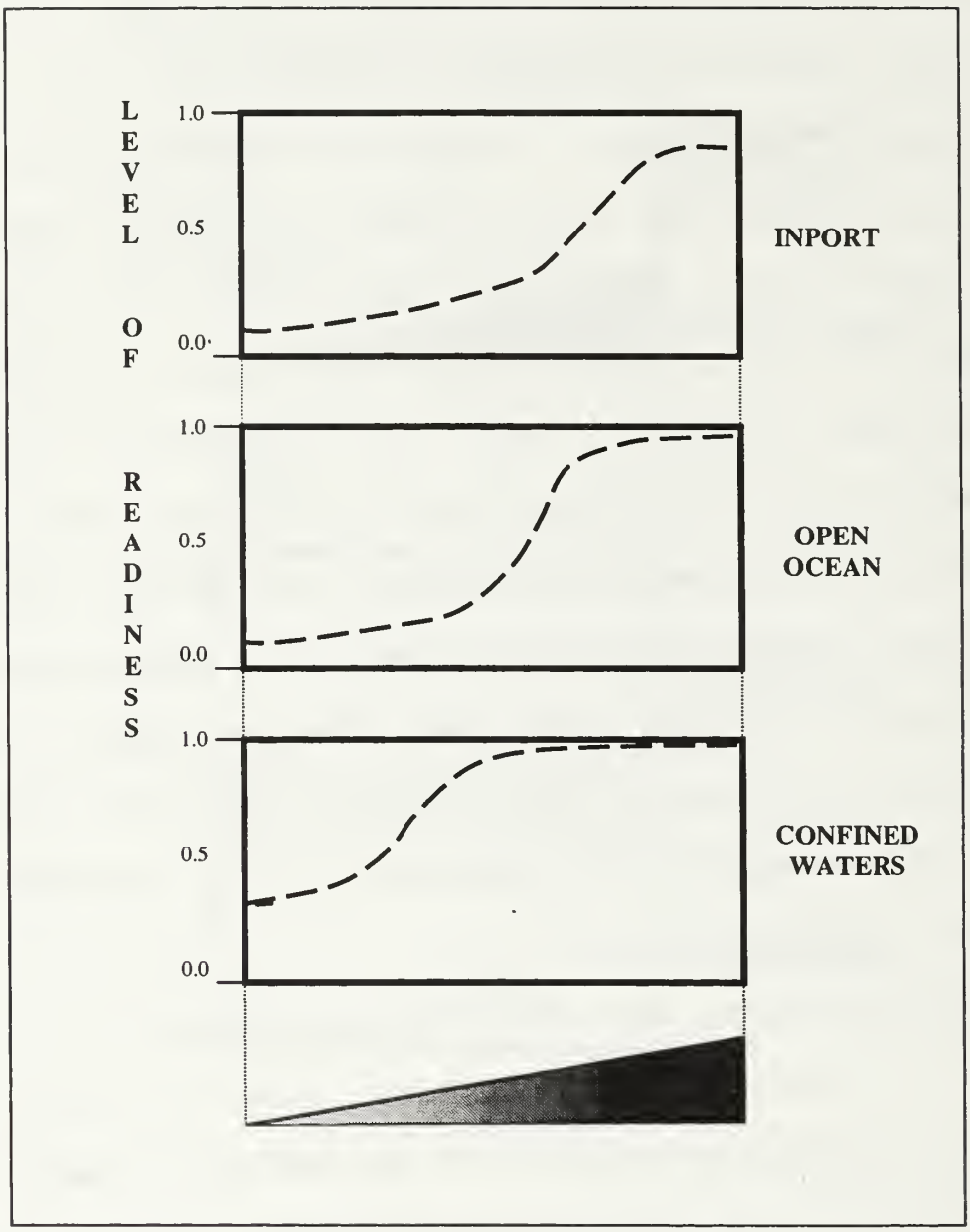

Figure 2. Readiness Curves Across the Spectrum of Conflict in the Three Geographic Areas

A key part of equipment readiness is the person operating it. The reliance on human factors requires an individual to be vigilant and most importantly properly trained. The training involves knowing how to properly operate the equipment. Every crewmember must be properly trained and familiar with all weapons and equipment available on the ARSHIP for self-defense. The weapons and equipment are only as good as the sailors using them. More than the ability to operate and repair the equipment is needed. The skill and experience of understanding what to look for is a critical part of the equation. In addition, the threat must also be reported in a timely manner.

If integral equipment is not operating, a threat may approach undetected. Often while *inport*, radar and other detection equipment are not manned or operated. The same can be said for weapon systems. During *inport* periods, a quarterdeck watch is posted along with a roving watch. The remainder of the crew is conducting maintenance, sleeping, or on liberty. If conducting "Sea and Anchor Detail" operations in *confined water*, crewmembers may be too occupied to properly monitor detection equipment.

Unlike transiting to port through *confined water*, the daily routine associated with *open ocean* operations can become monotonous and dull the senses. The designed CONOPS

of the ARSHIP does not allow much slack to break the continuous schedule day after day for extended periods.

As the vessel and crew's readiness can fluctuate, the leadership that dictate the heightening of strategic and tactical readiness are also influenced by events taking place around them. The command elements, which usually think in terms of conventional threats, evaluate the situation and order the perceived level of sufficient readiness. As the conflict escalates, conventional warfare thinkers prepare for possible attack. As illustrated in Figure 3, the area above the readiness curves represents the latitude that potential attackers have relative to their target. The reason for the curves never reaching full readiness lies in the inability to properly prepare for all possible attacks, conventional or unconventional.

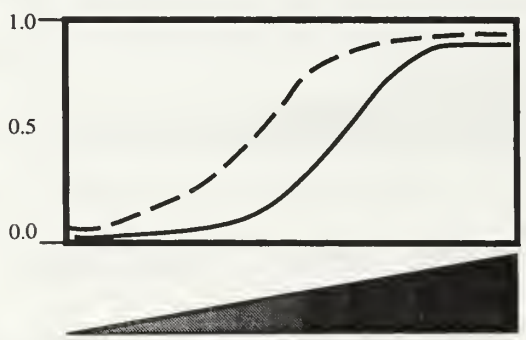

Figure 3. Actual Readiness Curve Versus Perceived Readiness Curve Across the Spectrum of Conflict

In Figure 3, the lower readiness curve depicts how conventional thinking will increase readiness. This means that the threats that might have been effective earlier in the conflict spectrum subsequently become challenged. This does not eliminate them as options, but they will face additional obstacles. The conflict moves from left to right across the spectrum. The upper curve represents how readiness should increase with the addition of thinking of unconventional threats as a feasible threat option. This separation between conventional and unconventional thinking forms an area between the curves.

Using the Figure 1 discussion to frame the situation, a conventional mindset only acknowledges the range of conventional weapons as the threat. For unconventional threats having unlimited range, the "distance" from the threat is not as great as perceived by the conventional leadership. This "distance" becomes an advantage the adversary can exploit through the utilization of long range special operations.

E. PREEMPTION AS A THREAT

Understanding why a state would conduct a special operation against the ARSHIP shows how such an operation fits into the context of the conflict. In times of relative peace, the political utility of a special

operations mission is higher than during an actual armed conflict where the special operations would have tactical utility. Context poses issues that are regularly forgotten in traditional U.S. military thought. Referring back to the section on political utility and singularity, and coupling those theories with the issues of readiness across the spectrum of conflict, we suggest that a preemptive or preventative strike is one of the greatest threats to the ARSHIP.

Prevention is a form of non-attributable aggression prior to a conflict. This is a viable option that is executed under the premise of deterrence and defense. In the case of the ARSHIP, it is suspected of participating and playing a key role in a forthcoming conflict and targeted on that premise. This targeting can be accomplished long beforehand, dependent on the time to repair or replace it, thus preventing the ARSHIP from being utilized effectively in the conflict.

Preemption is aggression utilized at the outset of conflict. This kind of strike would be utilized to initiate hostilities based on a key component of the U.S.' defense or retaliation forces being neutralized. The attacker would want to employ a one-time surprise to take out key nodes in the U.S. military potential and exact the

highest toll. The purpose is to raise the probability of success of the future engagement.

IV. POTENTIAL SPECIAL OPERATIONS THREATS TO THE ARSHIP

By using the definition of special operations the previous list of possible threats has been refined. The elimination of threats, such as mines, artillery and missiles, and all large pieces of military potential becomes apparent as one distinguishes conventional from unconventional. These threats can still be used as the delivery platform to position an unconventional threat within attacking distance. However, we will only focus on threats that can be used directly against the ARSHIP. The threats this chapter focuses on are: combat swimmer, mini-sub/manned torpedo, assault force, boats, and aircraft.

Chapter IV is organized in a way to illustrate precise operational options against the ARSHIP's defense, and illustrate their effectiveness and substitutability for other courses of action. This organization begins by outlining the characteristics of the operation's attack modes, its objectives (the critical nodes of the ARSHIP) and the means of meeting those objectives. The center section of the outline elaborates on the mitigating factors limiting the aggressor, the environmental constraints, and the defense constraints the specific course of action is faced with or can exploit. These will be put into

perspective in the third section of each operational outline. There the operation's likelihood of success and employment, its probable effectiveness and its utility relative to other operations are examined.

A. COMBAT SWIMMER

1. Modes

SUB-SURFACE: This mode utilizes divers to approach the ARSHIP under the water. A team of divers can approach as a convoy or the team may be broken into pairs to reach the target ship on their own, so as not to become entangled with others in the dark waters. A classic example of a combat swimmer mission is the U.S. Navy SEAL mission during Operation Just Cause in Panama that destroyed Manuel Noriega's yacht. Although that mission was able to destroy the target, the size of charges that divers can carry limits the amount of damage that can be exacted on the ARSHIP.

Divers need to be launched from some sort of platform. The platform needs to bring the divers within swimming range of the target. This can be done from land, boats, or air but must be unobserved. A parachute jump or helicopter cast can effectively bring the divers or their subsequent small boats to within close proximity to their target area.

Combat swimmer operations would normally be carried out at night. However, murky waters of harbors may allow divers to approach the ARSHIP undetected in daylight. The divers breath compressed gases that allow for an oxygen rich mixture to circulate through the lungs and a carbon dioxide scrubbing system. Most re-breather closed circuit scuba units use granules of a substance that absorbs CO^2 and allows the volume of unconsumed O^2 to loop back into the system. This allows extended duration dives up to four hours. Elite forces utilize the closed circuit scuba equipment for insertion and combat swimmer missions for this reason because there is no bubble trail on the surface following the divers.

A combat swimmer mission, due to the speed limitations of a human, can only be accomplished while the ARSHIP is *inport*. The mission must also have sufficient intelligence to be able to locate the ARSHIP, its pier, slip or anchorage. This is important because the combat swimmer utilizes charts and tide tables to plan the route to reach the target from their submersion point. The divers go from point A to point B underwater utilizing tidal current vectors and swimmer vectors to calculate an underwater compass course. This compass course is only effective when the launch points are exact, the target is where it is

supposed to be, and the two competing vectors of swimmer advance velocity and current velocity are predicted accurately. The stealth of this depends on remaining submerged throughout the mission. Coming to the surface to "peak" and see if you are on the right track is extremely dangerous in hostile *confined waters* with active patrol boats.

SURFACE: Surface swimmers have less of a tactical surprise advantage due to the fact that there are heads or other appendages breaking the surface of the water allowing for visible detection. Surface swimmers, traveling alone or in an organized team need to be launched from somewhere near the target. However, surface swimmers may have similar objectives as the submerged divers.

2. Objectives

There are two possible objectives of the combat swimmer mission. The first is to reach the ship from the water, place explosive charges on critical components, and swim away. The second is to utilize the stealth of the water to approach the ARSHIP in order board the ARSHIP from the water's edge.

DAMAGE: The objective of causing damage is straightforward. It involves surreptitiously attaching explosives to the outside of the ship on critical nodes.

Due to the relatively small size of explosives that can be hauled in by divers, the critical nodes of a steel-hulled warship are small in number. It is physically infeasible to carry enough explosives to the target via divers to 'kill the ARSHIP.' However, the critical nodes below the water line do allow for enough destruction to effect its mobility. Nodes such as the struts, which hold the shaft, can be destroyed so the weight of the shaft will bend itself, rendering the ARSHIP immobile until it can be dry-docked and repaired. Likewise, nodes such as variable pitch propellers can be warped so as to produce cavitation or high speed warbling of the ARSHIP. Both negate its stealth advantage. The packing glands are weak points that make the hull more easily breached. Shaped charges can pierce the outer hull but must be placed outside of critical electrical or propulsion spaces that are located near the external hull to have the greatest effect. All of these targets produce short-term effects that only delay the availability of the ARSHIP or its speed of advance toward an area of employment.

BOARD: The concept of the assaulting force will be discussed later in this chapter. There are similar concepts to the combat swimmer and the waterborne assault.

These will be emphasized here whereas their objectives will be discussed in Section C.

3. Mitigating Factors

Aggressor Considerations: There are many physiological constraints when divers breathe high percentages of oxygen under pressure. "O^2 toxicity" is the diagnosis for prolonged exposure to compressed Oxygen that results in nervous disorders. Unclassified but indicative numbers warning of O^2 toxicity range from 4 hours exposure when breathing O^2 at 20 feet depth to 10 minutes of exposure at fifty feet. Death can result, especially if irresponsible diving has gotten the divers within proximity of their target but the medical emergency has forced them to surface. By doing so, they have exposed the operation, costing their own lives and threatening those of the other divers. This is not a common ailment, but is a factor in the training of responsible diving tactics.

Physical limitations of the divers include the amount of explosive they can carry, the speed at which they can swim, and their exposure limits to extremely cold water. The speed of the swimmers makes it impossible for them to achieve contact with the ARSHIP while it is underway. Additionally, if the water currents are such that the swimmers cannot overcome opposing currents they will never

reach their target. The extreme cold of the water will dictate the type of thermal outerwear worn to protect the divers from hypothermia. However, water exchanges heat 80% faster than air, and prolonged exposure regardless of thermal protection will eventually endanger the divers.

Characteristics of the equipment utilized for this mission profile can both add and detract from the effectiveness of the mission. One such characteristic is the compressed O^2. Normal scuba tanks hold enough air for a one to one and half-hour dive. Compressed O^2 tanks circulating through a scrubber can extend shallow dive times to four hours. Inert gases mixed with O^2 extend those physiological limits beyond four hours. This translates to a difference of underwater movement from 3000 yards to a possible distance of 7500 or 8500 yards. Even more influential is the distance the divers can swim on the surface from their launch platform to their submersion point.

Another limiting characteristic is the explosives and the detonation devices carried. Clock detonators placed on 5-10 lb. shaped charges are the community standard. Each diver can carry two of these. A sizable force could send 5 pairs to a target. This translates to around 75 lbs. of explosives placed at critical points on the ARSHIP.

Sounding impressive and actually being effective are two separate things. One substitution would be to carry traditional haversacks of explosive, which would double the amount of explosives placed under the ARSHIP, but haversacks do not have attaching mechanisms nor are they shaped charges. This quantity is not enough to break a keel and permanently sink the ARSHIP.

Environmental Considerations: The primary medium concern of these types of missions is exposure time in the water and the amount of thermal protection needed to keep the body warm for prolonged mission duration. Beyond the normal constraints of exposure, swimming in confined areas poses issues of water clarity and silhouette visibility from the surface. This is only an issue for surface surveillance during the day or a full moon where the water is clear and the bottom is contrasting the divers. One phenomenon of many bodies of water is bioluminescence; organisms in the water that glow when excited by motion. A swimmer, whether on the surface or submerged, may have the misfortune of exciting them by disturbing the water. This glow, a bright neon color, can vary in intensity. If bioluminescence qualities are high, the glow could easily be seen from long distances if near the surface, or deeper if the water is clear.

In the discussion of biology, we must consider that the swimmers share a medium in which they are no longer on the top of the food chain. Mammals and fish in the water can react adversely to the presence of a foreigner. Their reactions can simply be the unusual barking of sea lions that would be considered as early warning defense, or it could mean becoming a hors d'oeuvres for "Whitey."

In bad weather, divers can get seasick when submerged in high sea states. The constant swaying without a reference plane can cause vertigo and nausea.

Defender Considerations: The readiness of the personnel on the ship plays a small role in defense from combat swimmer operations. The primary concern in this category would be under conditions of watch standing. The watchstander must diligently be scanning the waters near the ARSHIP and monitoring any defensive measures they have set out to repel a swimmer attack. This is a tedious and boring proposition. Likewise, the principle of a swimmer attack in a "friendly" port would also seem, to a watchstander, unlikely, causing him to let down his guard.

The ship's equipment does little the defense against a combat swimmer attack. If the ARSHIP design has one, its sonar could be radiated regularly at high power to disturb the inbound divers. The amount of power that a sonar dome

can emit into the water is enough to destroy eardrums and be especially uncomfortable for all semi permeable cavities of the human body. Suctions and discharges also pose interesting quandaries for divers who must travel up or down the length of the ship during the course of the mission.

A ship that anchored or moored to a buoy poses a more difficult navigational problem to the divers than a ship that is pier-side. There are few geographic references that divers can use to verify their path. Pylons, navigation buoys, quay walls, and pier lighting are excellent navigational aids to divers under the water who are attempting to find a target without breaking the surface to look. Additionally, the positioning of the ship in a well-protected and trafficked waterway poses a threat to the divers of being run over or spotted if they experience difficulties and must come to the surface. Remembering the issues of human limitations due to the speed of currents, the ARSHIP could be strategically located near river inlets or power plant cooling discharges to create a current that is impassable.

4. Utility and Substitutability

Cost and Asset Availability: The personnel required to accomplish this mission profile need to have the training

to dive using closed circuit scuba, navigate underwater, handle underwater explosives. The closed circuit scuba system can be found commercially and there are many amateur and professional divers who navigate well underwater. If these personnel were to be commissioned and given the mission profiles of what to carry and where to put it, they could successfully attempt this mission. Elite units throughout the world's navies train for this mission regularly. The extent of their training may be costly, but most definitely increases their probability of effectiveness to near perfection.

The cost of a closed circuit scuba rig is around US$ 4000. A team equipped with enough explosives to do damage to a ship would then run about $60,000 to stand up. Additionally, the boarding party would be higher due to the number of personnel needed to secure the objective. This is not an inordinate amount of money relative to the likelihood of success due to the clandestine nature of the mission.

Benefit: Due to their clandestine nature and the effectiveness of their attack the combat swimmer mission has the characteristic of singularity. The effectiveness of only altering the ARSHIP's geographic location for specified time will alter the weighting that the decision-

maker will ultimately lay upon its relative utility. However, given the means of infiltrating a hostile port, or distanced port with lower defenses, this mission is allows for total anonymity, total clandestine success, and it is the most dangerous threat to the ARSHIP in any port.

B. MINI-SUBS AND MANNED TORPEDOES

1. Modes

Mini-subs and manned torpedoes allow underwater transportation at speeds and distances unparalleled by kick-stroke-and-gliding (swimming). This allows attacks to be launched covertly from platforms at greater distances and with greater destructive payload than the combat swimmer. The mini-sub and the manned torpedoes can venture into waters that are shallower and less maneuverable than those of conventional submarines. Many of the mini-subs and manned torpedoes are open to the water so the drivers or transported personnel must breathe compressed air and wear thermal protection.

2. Objectives

Transport vehicles can bring explosives to the ARSHIP from greater distances. Their advantage relative to the combat swimmer, besides distance, is the amount of explosives that can be delivered. These vehicles either can trail an explosives package behind them or be laden

with the explosives as in the case of the torpedo. The objective would be to place the explosive packages in a position where they would 'kill the ARSHIP' or do the most damage. The keel of a ship can easily be broken when a mini-sub trails 50 to 100 times as much explosives to the target as the combat swimmer. The manned torpedo can do the same with a terminal warhead that has carefully navigated to its target. The discussion of equipment limitations outlines the relative disadvantages the submersible transports have to combat swimmer operations partially offsetting this asymmetrical advantage.

3. Mitigating Factors

Aggressor Considerations: The same constraints present to combat swimmer are present here, except for the relative distances and speeds of advance. There are training constraints regarding navigation systems that are more sophisticated than the simple compass and chart work of the combat swimmer. All in all, the human factors involved with direct control and precision targeting are aspects that favor this mode of explosives delivery.

The fact that there is a rapidly moving transport at depth causes certain safety issues to arise concerning dive physics and Pulmonary Over-inflation Syndrome (POS). These considerations can be trained for to near perfection.

However, the utilization of poorly trained personnel can result in mission failure and death.

Breathing equipment used on these transports by the crew is similar to that used by the combat swimmer. The speed of advance and mission duration may be dictated by the physiological limits of the crew or by the amount of fuel carried. Speed of advance, the transport's size, and noise-producing electronics on board make these transports detectable to passive and active sonar. Additionally, maneuverability is decreased compared to the combat swimmer. This is important in high traffic areas and tight geographical features. The size of these transports also produces a larger silhouette in clear water.

Environmental Considerations: Daytime operations are restricted by clarity of water and possible detection from above the surface. Moonlight and water clarity affect nighttime operations to some extent. Sea state plays a larger role with these transports due to their susceptibility to swells and their use of ballasting. High sea states and large swells can cause depth changes at a rate up to 6 feet per second. This rate is dangerous to the diver breathing compressed gasses. (The suggested safe rate of ascent to avoid POS is one foot per second.)

Exposure characteristics are the same as for the combat swimmer. Water clarity is more crucial do to the size and speed of these transports. The mission is not immune to biological constraints, and bioluminescence becomes more pronounced with speed. The threat of being a shark's lunch is however, greatly decreased.

Defender Considerations: The defender considerations in the case of manned torpedoes and mini-subs are much the same as for the combat swimmer. However, the active or passive sonar if turned on and monitored in port would have a better than zero chance to detect incoming mini-subs or manned torpedoes.

If the mission was designed for terminal guidance of a warhead, then the two transports could effectively target the ship while it is underway. Optimally, this would only be done when in *confined waters* and when the target has been positively identified. Higher speeds would cause 'louder' sonar signatures of the incoming warhead and possibly reduce the effectiveness of that type of mission.

The mini-sub and manned torpedoes are less affected by swift currents. Their navigation systems allow them to find their targets more easily and precisely without needing physical references. High traffic lanes, as

discussed earlier, impose navigational hazards to all submerged threats.

One large constraint is the movement of the submersible transports to the region of the target. It is easier to deliver divers and their scuba equipment to a region than a large torpedo or mini-sub. The ability of the attacker to do that will play greatly in mission selection.

4. Utility and Substitutability

Cost and Asset Availability: The personnel constraints are similar to those for a combat swimmer. However the likelihood of procuring commercial mini-subs is low. Drivers could come from the pool of experienced divers and would only need to be trained on this submersible vehicle. Relative to the combat swimmer, this mission would require less personnel to have the same or higher destructive effects; one to six man units.

Many countries have hollowed out torpedoes and added controllable steering and speed to enter this mission specialty. The crudeness of the transport will make more demands on the crew. The transport is difficult to acquire more so due to required navigational equipment rather than the submersible vehicles. However, commercial and military

sonar can be easily adapted to create an onboard navigation system.

Benefit: Mini-subs and manned torpedoes are another means of clandestinely infiltrating a waterway not accessible by conventional submarines to exact a toll on the ARSHIP. The quality of singularity of these methods is due to the fact that this mission can actually deliver enough explosives to 'kill the ARSHIP.' The main differences between the combat swimmer and the submersible transports are the embedded internal and external constraints. These are based on the objective of the mission, the availability of the assets, and the underwater geography of the mission area. If the objective is to kill the ARSHIP, the submersible vehicle is the only method to bring explosives to the ARSHIP underwater.

C. ATTACK FORCE

An attacking force can come from all three traditional mediums, sea, air and land. This section will address all three modes of attack as well as their relative advantages and disadvantages. One mode of launching an assault will not be discussed in this section, the combat swimmer assault. The reason for its lack of discussion is due to its dual nature. First, the ingress of the combat swimmer assault is the same as an explosives attack. Secondly,

once on board the force acts like any other, with the same objectives. The only difference is that the ARSHIP must be stationary and the swimmers climb from the surface of the water vice from a boat.

1. Modes

SEA: An attack force directly launched from a vessel inspires thoughts of swashbuckling and piracy. There are distinguishing characteristics of these courses of action. The primary distinguishing characteristic of is the size of the vessel coming alongside to launch boarders assaulting the ARSHIP. The three primary categories are small boats, large boats, and ships. Small boats are craft 30 feet in length or less. Large boats are from 30 to 90 feet, while a ship is larger than 90 feet. Sub-categories of these are distinguished by the type of the craft; commercial, leisure, or military.

The sea threat is one where boarding can only take place when direct contact of the two vessels occurs. The boarding team can climb aboard the ARSHIP via a flexible hook ladder to carry out their mission. This boarding can take place in all of the geographic areas. The sub-categories have large ramifications as to when the approaching attacker will be distinguished as a threat. On first glance, smaller vessels would warrant less alarm as

they approach due to the cognitive bias of the observers on board the ARSHIP. Likewise, leisure and commercial vessels would warrant less of an immediate response. Therefore, it behooves the aggressor to select those vessels that would proceed closest to the ARSHIP without alarming the crew.

AIR: The air threat is very similar to the sea threat in that a delivery vehicle carries the assault team to the ARSHIP. Logically, this must be an aircraft with vertical lift capability, a helicopter. The assault team can be brought to the deck of the ARSHIP by two means, the helicopter landing on the deck or using ropes to execute a controlled descent from the aircraft to the deck. Modes of descending from a helicopter to the deck are fast-roping and rappelling. Fast-roping involves sliding a team down a 3 inch thick rope without hard connectors or safety harnesses. A team member wears insulated welder's gloves to hold onto the rope as it passes through their hands on descent. The control comes when the team member squeezes the rope prior to his collision with the pitching deck. This slows his downward momentum allowing for a controlled landing. A well-trained assault force can land 20 members from 60 feet using only one rope in about ten seconds.

With rappelling there are constraints of harnesses and hard attachment points to the rope that must be secured

before descending and discarded upon reaching the deck. Depending on the number of ropes, a well-trained team can land 20 members from 60 feet in about 90 seconds. The advantage of rappelling is the longer length of possible descent. Fast-roping is only feasible for distances of less than 75 feet, whereas rappelling allows landing from heights up to 150 feet.

The use of gliders or parachutes to land a team onboard the ARSHIP is likely only when the ship is in port. Execution of a mass landing of parachutes from any drop height onto the ARSHIP requires great skill and training. This would only be by maneuverable parachutes, such as those commonly flown when sky diving and not static line deployment. Gliders like those used in World War II would be effective during nighttime. However, being able to land one or more gliders specifically onto a target the size of the ARSHIP would be nearly impossible.

LAND: Land assault on the ARSHIP is possible when the ship is tied to a pier. The land assault would entail the assault team either forcibly entering, clandestinely entering, or overtly entering a naval base, and then proceeding to board the vessel. The assault team would need to strike swiftly with precision and not expect to stay long in the target due to follow-on security forces

being alerted. The team must utilize the element of surprise before hostilities begin. This method of insertion onto the naval base could utilize small boats, parachuting, swimming, or over land navigation to reach their objective. Overt ingress to the target can be accomplished under the ruse of pretending to be 'indigenous' personnel or activities that do not look out of the ordinary. A force could hide in a delivery truck, or wear local military fatigues executing a routine entry onto a base. Red Cell activities of SEAL Team SIX in the 1980's exposed the vulnerabilities of the United States' Naval Bases. They utilized all of the tactics described above with great success.

2. Objectives

Whether an assault force ingresses from sea, air or land, its objective is the same. The mission is dictated by the strategy, recalling the list in Chapter III of the five effects that an attacker would want to achieve on the ARSHIP. These mission drivers dictate the size of the force, the amount and type of arms carried by that force, and the specific actions at the objective.

The first objective of any assaulting force would be to neutralize the crew. First and foremost, the crew must be killed or detained. Deadly force would require the

assault team to use hand-held weapons or quick-acting deadly chemical/biological agents from which the team was protected. Non-lethal force would require a more permissive environment than is normally associated with an U.S. warship.

To sink the ARSHIP, the assault team would most likely need to place huge amounts of explosives on board the vessel in strategic places. This would take time and extreme amounts of exertion. The amount of explosives necessary to sink a warship would be difficult for an assault team to bring onto the vessel without follow-on delivery. Each member of the assault team would be required to carry at least 35 lbs. of high explosives. This would severely inhibit on the mobility and efficiency of the team.

To affect the ARSHIP's geo-position, propulsion or steering machinery would need to be temporarily or permanently destroyed. The extent to which the United States Navy could repair or replace the damaged equipment would determine the effectiveness of that mission.

A major concern is that the ARSHIP could be hi-jacked and piloted by the assault team to their position of choice. Remotely piloted or not this would require the destruction of communications equipment. For those

instances where a team was not able to seize the crew, they may enter into the labyrinth of passageways and proceed internally to objective points. If the team were to be able to breach into internal passageways they may be able to head directly to critical nodes, such as propulsion, steering, and electrical generators.

To affect the ARSHIP's rate of fire or probability of hit, the assaulting team can distract the crew to the point that it is more occupied with fighting than firing missiles. Moreover, if the ship's fire control is by remote targeting, the assault team need only destroy or impair the communications nodes on board. Falling short of seizing the crew or the vessel, the assault team could proceed to a secondary objective of destroying critical topside nodes. The assault force could also destroy the hydraulic mechanisms on the VLS tube hatches, which would make it impossible to launch those missiles. Topside antennas would be easy targets as well. In the instance of a portable antenna being used to replace a destroyed one, the decreased link margin coupled with a raised bit error rate may cause mis-targeting data or delay the rate of fire. The decreased link margin and raised bit error rate is due the fact the replacement antenna has considerably less gain. Any node that would permanently or temporarily

slow the rate of fire of the ARSHIP can be accessed with a well-trained team once onboard, even without the seizure of the crew.

3. Mitigating Factors

Aggressor Considerations: An assault team must have enough personnel to accomplish entry and seizure of the ARSHIP. Its size will also depend on the advantage the assaulting team expects to achieve by surprise. An assault that has strategic and tactical surprise will require fewer personnel and expect less attrition than one that has lost surprise.

The amount of equipment carried by a team member should not exceed a physical and tactically effective limit. A human male may be able to pack 125 lbs. However, that weight would be cumbersome and tactically inefficient. A reasonable expectation for a load of equipment or explosives would be 35-40 lbs. Considering that most assault teams would be tethered by communications, this would exclude some members from carrying a load of explosives. Additional breaching equipment and charges would be distributed among the assault force at the expense of loading explosives. Without means of mass destruction there is only so much critical damage that the assault team

can do in a short amount of time beyond seizing the crew and vessel.

Other limitations of the personnel depend on training and their competency with fast-roping, climbing aboard from craft alongside the ARSHIP, and weapons and demolitions experience. In addition, the expertise required to land a parachute on the vessel and then begin conducting an assault takes extensive training. Seemingly, the boarding of an U.S. warship requires the skill of professionally trained elite units. These skills are found in trained military, mercenary, and organized crime (pirate) units.

Necessary equipment to accomplish these methods of attack depends on the objective and mode of attack. An *inport* assault requires little additional equipment beyond whatever the team would utilize to reach their objective and breach the defenses of a naval base.

Waterborne assaults require ladders and assault craft. The limiting factor on the assault craft is its maximum speed of advance and handling characteristics. Small and large boats offer the greatest maneuverability. However, their speed of advance across high seas, their limited range, and the length of the freeboard that the assault team must climb, become limiting factors of their employment. Additionally, the size of the boat utilized is

governed by the amount of personnel it is must carry, the amount of fuel it can carry and the speed of advance that is necessary to transit long distances under strict time constraints e.g., (the cover of darkness). Of note, smaller craft can be delivered by aircraft (parachute) or helicopter (cast) to within a reasonable range of the ARSHIP.

Helicopters used for an air attack need to be large enough to carry troops. Fast-ropes or rappelling ropes are easily acquired. However the helicopters are constrained by the distance they can travel when laden with troops and ammunition. This projected range from probable launch points should be considered as a factor in their defensive posturing.

Environmental Considerations: Low visibility, once the aggressor has located and identified the ARSHIP, is to the advantage of the attacker. The movement of a relatively small force, small watercraft, slow moving air vehicles, or indigenous craft and vehicles go relatively undetected in low visibility. Constant alertness inherently decreases a passive defender's perception of the threats' ability or probability to assault the ARSHIP.

During the light of day an assault is less likely to occur unless the attacker does not have the ability to

locate and identify the ARSHIP at night. In this instance the attacker would approach under the ruse of being an indigenous activity. During the night, the illumination of the moon plays a great role in exposing a force. Sheltered from sight by darkness, trained units can almost always approach the ARSHIP undetected and achieve tactical surprise.

Weather considerations such as sea state will have great effects on smaller waterborne assault craft. This will determine their range and maneuverability, as well as how seasick the assault team gets before they reach the ARSHIP. Wind affects the likelihood of an approach and ability of landing a team onboard a moving ARSHIP. The helicopter may be constrained from physically landing onboard the ARSHIP, and the wind swept ropes may make the assault team fall short of their intended landing points. Additionally, sea state adds complications to roping onto a pitching deck. The rope is to maintain contact with the deck. As the deck moves upward and downward relative to the ropes hanging from a stationary helicopter, there is a danger of the ropes no longer reaching the deck when the ship is in a trough. Another problem is if the deck accelerates upward at a descending team member when the ship hits a peak. Additionally, a wet and pitching deck

can make tactical movement difficult for the assault team. Despite the difficulties of conducting an assault in bad weather, that is the time when an assault is least expected and the ARSHIP is the most vulnerable.

Medium characteristics play less of a role in the assault force unless exposure to wind, rain, sea state, and ambient temperatures would render members of the team physically ill to the point that it degrades their mission or excludes them from the mission leaving the team short handed.

Defender Considerations: Readiness is an issue that has been discussed at length. The principal factor to observe is that attacks are most likely under conditions of darkness or foul weather.

The speed of advance alluded to earlier will affect missions that attempt to board a moving ARSHIP. By altering speeds and sharply changing directions the ARSHIP can affect the ability of an assault force to board as well as buy critical time to form a "security alert force" to repel boarders.

In the *open ocean*, small boats are less likely to independently transit distances farther than 75 miles under cover of darkness. Alongside a pier, the ARSHIP faces the threat of land assault that has repeatedly been executed

successfully by Naval Special Warfare units. The ARSHIP should be cordoned off in more secure basing, much like submarines and special weapons.

4. Utility and Substitutability

Cost and Asset Availability: Personnel for a coordinated assault need to be highly trained unless the assault is merely a suicide mission. The suicide mission merely requires the personnel to gain access to the ARSHIP and then detonate their explosives. Elite units can most likely only carry out a smooth and efficient assault. These units are not difficult to acquire in the case of mercenary units and pirates, both of which work for money. Trained military units, however, are more difficult to acquire and take time and preparation before they are seasoned enough to attack and expect success.

The assault platform is one of the major limiting constraints. Helicopters and large commercial vessels are high-ticket items. Therefore, powers that have limited resources are far more reluctant to employ this type of mission. Small boats and indigenous boats however are more readily available for acquisition and the cost of their loss is more tolerable. The least costly of all is the land assault, requiring only a minimal investment at times.

Benefit: The prospect of seizing the ARSHIP is one that would make any aggressor salivate. Additionally, a successful attack on the ARSHIP would be politically and strategically impressive, attracting great attention. If the ARSHIP were operating in a region that was thought to be safe but nonetheless was attacked, either fleet tactics would be changed or the ARSHIP would attempt to move further from those areas of vulnerability. The latter would move the missile ranges of the ARSHIP out to sea, affecting the probability of hit as discussed in Chapter III.

Because of the ARSHIP's small crew and minimum defenses, the ability of a trained force to board and seize it seems high. The attack would be almost as simple as boarding a hostile commercial cargo ship, which pirates in Asian waters accomplish almost routinely.

The larger question is the likelihood of the approach being discovered and thwarted. As discussed earlier, small or indigenous vehicles have higher probability of success gaining proximity to the vessel undetected or unnoticed. Additionally, the capabilities granted to nodal destruction or seizure by an assault force greatly outweigh the precision of inbound missiles, torpedoes or projectiles.

This makes the threat of an assault highly productive for its investment.

D. BOAT ATTACK

The discussion of boat attacks will center on their use as a weapon platform against the ARSHIP, and not their use as a personnel delivery platform. To see how a boat can be used as a launch platform, refer to Section C. That section will also be useful to understand the limitations and capabilities of different styles and sizes of boats. 'Boats' in this section include earlier defined vessels as well as commercial and leisure vessels that may be larger than 90 feet. Boats have the ability to converge on the target with a minimal amount of suspicion. The covertness of this approach lies in its ability to appear innocent and non-threatening.

1. Modes

Along almost every waterway in which the U.S. Navy operates, there are local users that rely on that same water for their existence or recreation. These users are fisherman and merchants that move their goods by boat. Additionally, recreational boaters may be on the water

enjoying themselves and their surroundings. This activity (clutter) becomes commonplace while operating in littoral waters near landmasses or on the open seas along sea-lanes. The ARSHIP may detect boats visually or electronically, but many times not perceive them as a threat. The attacker's ability to take advantage of this will allow him to approach within weapon release range.

2. Objectives

Once within range, the boat can fire at the ARSHIP with small arms, machine guns, large caliber weapons, rockets, or torpedoes. The attacker's goal dictates the targeted node on the ARSHIP. To kill the ARSHIP, the attacker would need to destroy the watertight integrity of the hull. Loaded with explosives, a boat could come alongside the vessel and detonate deadly cargo. The explosion can destroy machinery and vital equipment in the direct vicinity of the blast or breach the hull and flood the compartments. However, the explosion would have to be large for the blast and subsequent flooding to sink the ARSHIP. A torpedo attack would have the same desired effect as a boat loaded with explosives. Damage to navigation and propulsion equipment can render the ARSHIP unable to maneuver, making it either incapable of leaving port or requiring a return to port for repairs.

The goals of influencing the geo-location and the rate of fire of the ARSHIP can be accomplished by boat attacks. By using weapons such as small arms, machine guns, large caliber weapons, and rockets, the small boat can attempt to destroy or damage the vital equipment required to navigate, communicate, or launch missiles. The size of the attacking boat is dependent upon the size and weight of the weapon being launched from it.

Small arms can be used effectively to eliminate the crew and to a lesser extent damage vital equipment. Machine guns can be used against people and equipment with greater effect. Machine gunners can rake the ARSHIP's exposed topside appendages. Large caliber weapons and rockets will accomplish the same results, but these weapons possess more destructive power. A .50 caliber machine gun can cause severe damage to equipment that is vital for the ARSHIP to perform its mission. Targets might include antennas and exposed communications equipment used for the reception of information for the missiles, navigation or communications. This will result in the ARSHIP's inability to target and launch missiles in an efficient manner and hinder its ability to radio other vessels.

Random firing at the target may or may not strike vital equipment, but the psychological effects can

accomplish a strategic result. Boat attacks can drive the ARSHIP from its present location as it maneuvers to avoid the actions of an aggressor.

3. Mitigating Factors

Aggressor Considerations: The skill required to operate a boat is possessed by any individual willing to do so. No formal or special training is required for smaller vessels but some commercial boats may require licenses. Unlike the driver of the boat, the individuals operating the weapons need to be properly trained. Some of the more complex weapons and systems need more training compared to firing small arms.

The only additional skills required, other than those previously mentioned, are navigation and target recognition. Electronic or "dead reckoning" navigation requires skills that are not necessarily difficult but are also not intuitive. Additionally, the individuals targeting their weapons need to be able to identify vital equipment on the ARSHIP. To be effective, they need to be able to recognize vital equipment from non-vital appendages onboard the vessel.

Equipment choice, either the boat or the weapons, depends on the aggressor's intention and resources. The size of the boats available may govern the type of weapon

or weapons the attackers can select to accomplish their mission. The geographic area in which the ARSHIP is targeted also influences the choice of boat size. If an aggressor must travel out to sea for any great distance, a larger boat may be needed. The boat will need to have fuel capacity and sea-worthiness to transit the respective range and operate in the conditions of an *open ocean*. Therefore, the type of boats available to an aggressor will govern the range at which the ARSHIP can be struck. The addition of navigation and detection equipment will be required when transiting large distances to locate and attack the ARSHIP.

The choice of boat and weapon may be dependent upon the aggressor's ability to procure them. Small arms or machine guns may not provide sufficient firepower to carry out the task assigned. If the aggressors want to destroy or damage a specific piece of equipment, they may require a rocket or large caliber weapon. If a longer range or more destructive weapon is necessary to achieve a desired effect, an adversary may not have the necessary resources to possess it. If this cannot be accomplished, an alternate weapon or platform must be selected to accomplish the same desired mission.

Environmental Considerations: The ability for a boat to approach undetected is to the advantage of the

aggressor. On the other hand, low visibility associated with rain, fog, or snow, affects the adversary's weapon performance due to their visual sighting characteristics.

Boat attacks may be attempted during the day or night. The advantage of a daylight attack is the ability of the aggressor to see specific targets onboard the ARSHIP. The disadvantages normally associated with overtly approaching a target in daylight are countered by the aggressor boat's ability to appear to be an innocent and non-threatening vessel. Nighttime attacks add the ability to approach visually undetected. Unfortunately, the ability to visually identify critical nodes is also degraded. An attacker may need to provide illumination with spotlights to locate vital nodes.

The use of or lack of navigational lights plays in favor of the attacking boats. By appearing to be what they are not by using false navigational lights or not using them at all, potential threats can appear to be innocent. The reliance of U.S. Naval Ships on nighttime navigational lights to classify ships can be used to the advantage of the aggressor.

Sea state has the greatest effect on boat operations. Smaller boats have difficulty operating when the sea state rises. This can cause a boat to be unable to transit long

distances out to sea or even result in it capsizing. A higher sea state may require a larger boat to survive the transit to the target. The pitching and rolling associated with an increased sea state will affect the accuracy of ballistic and fire-and-forget weapons. In addition, the boat crew may lose their balance, fall and injure themselves, or be swept overboard. Another factor associated with a pitching and rolling boat is the possibility of the crew getting seasick. This may render them incapacitated and unable to conduct the operation.

Temperature also plays a role in a boat attack, although to a lesser extent than other factors. Sea spray from the boat combined with cold air temperatures can effect exposed weapons. These weapons may then be rendered inoperable or less effective than normal.

Defender Considerations: Readiness has been discussed throughout this thesis. Associated issues to be recalled include the alertness of the crew, the suspicions placed on closing vessels, and the training of watchstanders. However, in the case of boat attacks, the readiness of topside weapons plays an integral part in ship defense. Readying a .50 cal machine gun for action is a tedious endeavor entailing "head spacing and timing," not just loading, pointing and pulling the trigger. Additional

items, such as surface search radar and passive sonar, are detection devices that must be monitored closely to identify potential threats from unmarked or falsely marked vessels.

The design of the ARSHIP calls for it to have a maximum sustained speed of 22 knots. Small boats possess speeds greater than this, usually in the 30+ range. This speed advantage gives the aggressor a tactical advantage over the ARSHIP. The aggressor boats can maintain their positioning relative to the target and maneuver around the vessel.

The distance from land the ARSHIP can loiter and operate dictates the size and sea-worthiness of the potential aggressor boats. This, therefore, can be used as a deterrent measure by denying the aggressor boats access to a target that is outside their maximum range.

4. Utility and Substitutability

Cost and Asset Availability: The training for a small boat attack is minimal. The boat driver will need little to no training. While the individuals using the weapons will require training on the operation and targeting of each weapon. The cost of training personnel associated for a small boat attack is of little consequence to the organization or group directing its employment.

Small boats are easily procured at a relatively low cost. A greater expense is associated with the weapon chosen for the mission. The availability of the weapons may be high, as with small arms, or more challenging, as with large caliber weapons, rockets, or torpedoes. Major costs involved in boat attacks are accrued in procuring more sophisticated boats. Boats such as commercial fishing, shipping, or leisure boats are more expensive than small inflatables or speedboats. Overall, the investment of personnel and vessel is less when compared to that of a war vessel.

Benefit: The amount of critical topside nodes on the ARSHIP is limited. Antennas and crewmembers make up the extent of critical nodes that can be destroyed with hand held weapons. In the cases of collision or direct contact detonation of high explosives, the boat attack has higher effects against internal and structural critical nodes. The operation may not damage or destroy the target, but the attempt may alter the utilization of the ARSHIP in the future. Tactically, the mission may or may not succeed, but strategically, the desired effect may be obtained, which will cause the ARSHIP to reposition through fear of other boat attacks.

The cost of the required equipment, boat and weapons, and the possible effectiveness make the small boat option a viable threat with high utility. The gains achieved through the employment of a small boat attack outweigh the losses or possible failure to accomplish a desired objective.

E. AIRCRAFT

The term "aircraft" in this section encompasses ultralites, gliders, and any private and commercial airplanes and helicopters. This aircraft discussion will concentrate on their use as a weapon against the ARSHIP and not a delivery platform for other forces as discussed in Section C.

1. Modes

Like a boat attack that can approach without raising suspicion, an aircraft must rely on this strategy to approach the ARSHIP. An aircraft may seem non-threatening if it is operating along established flight corridors. Aircraft are primarily detected through electronic means by U.S. naval warships, but an ultralite or glider is almost undetectable by radar or electronic counter-measures (ECM). These small, lightweight planes have minimal to no radar signature due to the use of composite material such as aluminum, canvas, and fiberglass. The ability to fly low

and slow allows smaller aircraft to operate below automated detection thresholds of many air search radar. The ability to approach the ARSHIP in a non-threatening manner is an integral element necessary to close within range to utilize on-board weapons. In addition, many air defense missiles will not home in on an aircraft with little or no radar or infrared signature. An additional platform would need to be utilized to launch an aircraft for *open ocean* attack. Aircraft, such as ultralites, gliders, RPVs, and private and commercial planes, can also operate as a weapon, again by performing kamikaze missions on the target. Loaded with explosives, the plane can become a guided warhead. A small ultralite can be built from a relatively inexpensive kit and requires minimal skills to operate. A glider constructed of wood or composite material can operate undetected by electronic means. Like ultralites and gliders, a RPV can be constructed at a low cost and is hard to detect with electronic and visual means. A RPV as a weapon does not require a pilot onboard.

2. Objective

Once within range, the aircraft can be used as a flying warhead or to launch ordnance to accomplish its mission. The mission's goals and critical targets on the ARSHIP are similar to those of a boat attack. The

differences lie in how they are conducted. As a weapon, the plane can be loaded with explosives that detonate upon impact on the ARSHIP. Historically, this *kamikaze* style mission has proven to be an effective weapon as seen in WWII. It eliminates equipment and personnel without discrimination, and is a crude weapon compared to smart munitions. The fuel carried by the plane can also cause secondary explosions and fires on the ARSHIP.

In its role of launching ordnance, the size of the plane will dictate the amount and type of munitions it can carry. The munitions can be bullets, torpedoes, bombs, missiles, or a combination of some or all of them. Bullets can be used to repeatedly strafe the ARSHIP damaging or destroying vital equipment and the crew. This method may not have as much precision as other munitions, but it can be effective.

Bombs can have proximity fuses, which detonate the bomb above deck inflicting damage to anything topside. They may explode on contact with the deck with similar results. Additionally, shaped charge bombs can penetrate the deck to a lower part of the vessel and explode in the interior of the ARSHIP. The results of such an explosion could be catastrophic to the vessel's survival. The large circular area of probability of precision associated with a

conventional bomb means the chance of a direct hit is not as precise as a bomb that is guided to its target. Guided munitions or laser guided bombs (LGB) can receive terminal guidance information through an electromagnetic link. This ability was displayed during the Gulf War when U.S. warplanes made precision missile attacks against Iraqi targets. The stealth characteristics of the ARSHIP do not combat such guidance systems. LGBs can be dropped from larger platforms such as commercial aircraft.

3. Mitigating Factors

Aggressor Considerations: The ability to fly an aircraft depends on the technology associated with it. The skill required to fly an ultralite is minimal and training can be at a low level. The more advanced an aircraft is, the more training required to fly it skillfully. The skills needed for advanced aircraft make these pilots and aircraft unfavorable choices for suicide type missions. A trained pilot is an asset not easily wasted by an aggressor.

The choice of airframe depends on the aggressor's economical means and accessibility to aircraft. The aggressor may not have the financial ability to purchase a large private or commercial aircraft. Smaller planes may be all they can afford. The ultralite is not suited to

carry large munitions, but it can be fitted with explosives or the pilot can carry hand grenades. Grenades can be effective as demolition of topside equipment, attrition of topside security forces, and "Thermite" grenades can be dropped on the VLS tubes and burn into the missiles from above. In the role as a guided warhead, the ultralite can fly low and slow toward the target to avoid detection.

Accessibility is not a significant issue if the adversary can afford it. The problem arises when the aggressor's objectives require an aircraft that cannot be obtained. His plans must include aircraft that can be procured and maintained.

Environmental Considerations: Visibility affects the ability of the pilots flying small aircraft to locate the ARSHIP. Smaller aircraft rely on the pilot to visually locate the target and position for attack. Visibility is an important factor to conduct aircraft attacks with planes that are not technologically advanced.

Aircraft attacks can be attempted day or night. The target must be well lit to distinguish it from nearby vessels. Effective night attacks at sea are limited to when the aggressor has the ability to identify the ARSHIP from other vessels and obstructions. Daylight greatly aids in locating and attacking the ARSHIP from the air.

Precipitation and winds associated with bad weather can conceal the approach of an aircraft. The plane must be equipped with navigation equipment and the ARSHIP must be in a known location and diverging from its last known position slowly. The same weather that conceals the aircraft's approach makes it harder to locate and attack the ARSHIP. High winds can make it impossible for the aircraft to fly and interfere with its navigation. Head winds can reduce the aircraft's range and may render it incapable of reaching the ARSHIP.

Defender Considerations: To understand the implications of readiness and positioning, refer to the discussion of these issues of the ARSHIP in the previous chapter.

The speed of advance for the ARSHIP decreases the hit probability of conventional bombs, but a plane intent on crashing into the ARSHIP with explosives will be unaffected. In addition, a plane must have the range to attack the ARSHIP if it is in the *open ocean*. A small aircraft does not have the capability to attack across a large expanse of water.

4. Utility and Substitutability

Cost and Asset Availability: The availability of trained pilots depends on the type of aircraft that is to

be used for the attack. Training a pilot to use a more advanced plane will cost more than for a smaller plane that can utilize a pilot with lesser skills.

Aircraft are relatively expensive. Therefore, the cost is dependent on the aircraft used. The option to use a small aircraft such as an ultralite would reduce cost. These types of planes can be ordered and built from a kit at a relatively low cost to the aggressor, whereas, commercial jets can range into the millions. Commercial aircraft are more likely to be rented, commissioned, or hijacked for such a mission.

Benefit: The benefits are similar to those of a boat attack, but the difference lies in the speed an aircraft can operate and its method of approaching the ARSHIP in a non-threatening manner. The aircraft's speed gives the ARSHIP less time to react to an attack. In addition, the ship may not pay attention to air contacts if it has to track and maneuver constantly to avoid possible collisions with surface contacts in *confined water*. Overall, if an air contact can approach the ARSHIP via commercial or leisure flight corridors, it has a higher potential of sneaking up and swiftly striking the ARSHIP than boats. This is a likely scenario and is most effective in *confined water* near well-established flight paths.

V. CONCLUSIONS

A. DEFENSIVE MEASURES

After the discussion in the previous section, the question that remains to be answered is whether or not there is a way for an Arsenal Ship, with reduced manning and meager self-defenses, to counter an unconventional threat. There are both, strategic and tactical, defense measures that the ARSHIP can employ to deter, defend against, or lessen the effects of the above threats. A strategic defense measure is one that requires changes beyond the organic assets of the vessel. Strategic defense options affect the ARSHIP's CONOPS and political and naval strategies for its employment. A tactical defense measure is one used by the ARSHIP itself for self-defense. Tactical defense measures will influence the design of the ARSHIP. Some of these defense measures will enhance the defenses against conventional warfare threats as well.

B. STRATEGIC DEFENSE OPTIONS

Strategic defense options for this technological target are based in psychological operations (PSYOP) and deception, two actions of warfare that doctrinally fall under special operations in the United States. An option in this category is the use of phantom ships, created

electronically or physically, to deter, confuse, distract, or ambush the forces operating against the ARSHIP. The physical phantom ships can be constructed with an inexpensive and buoyant material such as wood, fiberglass, plastic, foam, or rubber. This can and should be augmented with radar and infrared reflectors and an additional infrared (IR) source. Deterrence, the first possible method of conducting conflict resolution in this case, takes two forms. Phantom ships could introduce a false number of ARSHIPs to the operating environment. This action can keep the opponent from attacking because of the perceived decreased probability of kill due to the numbers of ARSHIPs present. By presenting a larger than truthful number of targets the ARSHIP's probability of survival automatically increases. Quite simply, the opponent does not foresee that enough damage will be inflicted to the ARSHIP armada to affect the overall outcome of conflict, and the ARSHIP merely becomes a target of opportunity when it presents itself.

The second form of possible deterrence by this course of action would be to generate false escort ships, giving the impression that the ARSHIP is a well-defended target. The perception of escort combatants will lessen the chance of the ARSHIP appearing as an easy target. Unfortunately,

the use of false escorts will counter actions and technology utilized to hide the ARSHIP.

When considering the effect of these false ships, there are psychological effects that come to light. The first effect is produced by using these ships as a means to dissuade the enemy from contemplating or executing an attack. Essentially, these false ships will act as weapons sinks that draw off an enemy's weapon system or confuse his ability to discriminate between the false targets and the ARSHIP. The psychological effects of distraction and confusion can cause an adverse psychological effect on opposing forces. The forces conducting the attack will interpret their efforts as wasteful and more risky. This not only affects those forces operating directly against the ARSHIP, but also on the operational and strategic planners. Across this spectrum, the feeling of inadequacy caused by second guessing and internal dissension can exact high tolls on the upper echelon of leadership.

The last application of these phantom ships is for ambush. Reminiscent of past actions on the high seas, the Q-ships of WWI looked like regular merchant vessels and were employed to entice German U-boats. Once the U-boats surfaced to engage the 'ill-defended merchant', the Q-ship would drop its facade with deadly results. The Q-ships

were designed and equipped with enough firepower to destroy a submarine attacking on the surface. This type of PSYOP had a wide range of effects. In addition to eliminating the attacking adversary, it demoralized the enemy's forces. Operationally, one successful ambush by a false ARSHIP would cause a reshaping of tactics employed against the ARSHIP. In the case of the Q-ships, it led to German U-boats only conducting submerged attacks, thus lowering their success rate. Strategically, a successful ambush could lead to questioning the utility of attacks against the ARSHIP or which assets to employ.

C. TACTICAL DEFENSE OPTIONS

1. CONOPS

By addressing the ARSHIP's CONOPS and making changes to its proposed geographic operating areas the ARSHIP can effectively lessen attacks from smaller air and boat threats. Placing the ARSHIP 75-100 miles from land, this can exclude small gunboat and inflatable boat attacks due to their range limitations. The 75-100 mile range distance from land only moves the ARSHIP to sea by 10% of the total effective range of cruise missiles. This does not, however, exclude aircraft dropped small boats or larger boats but does lessen the threat from a certain target set.

This distance from land also places the ARSHIP away from normal air traffic lanes. Its reduces the likelihood of an air threat diverting from a 'normal' track and attacking without being noticed in a timely manner and countered.

Even, when not expecting attack or without indications of a potential boarding the ARSHIP should travel at speeds above 20 knots. These speeds effect the wind over the topside of the decks, making helicopter boardings slightly more hazardous and make small boat boardings more difficult because of the hull wake.

The consideration of escort ships and/or fast attack boats could be considered as deterrents and defense platforms augmenting the ARSHIP's meager defenses. However, these counter the stealth capabilities of the ARSHIP. The escorts, by their necessity to be near the ARSHIP to extend their defensive umbrella, will give away the area of operations of the ARSHIP.

2. Gun Mounts and Missile Platforms

Along with the strategic options, several tactical defense options must be considered for self-defense. The addition of gun mounts and platforms for the firing of shoulder fired missiles can be used to defend against many of the unconventional threats. The gun mounts should

accommodate M-60, .50 caliber, or Vulcan chain machine guns. These machine guns, with their high caliber, long range, and high rates of fire, can be used to repel a surface combat swimmer, an assault force, a small boat, and slow aircraft attack. The missile platforms can be used to fire RPGs, shoulder-fired air defense missiles, or recoilless rifles. The tradeoff considered in external mounts is the expansion of the ARSHIP's radar cross section. The mounts and platforms can be retractable to reduce radar returns and maintain the stealth characteristics of the ARSHIP concept.

3. Crew

With a reduced crew size, everyone aboard the ARSHIP must become an integral part of the ship's self defense force. The armory should be stocked for all options. Its inventory should include pistols, automatic rifles, shotguns, body armor, concussion, illumination and chemical grenades, 40mm grenade launchers, RPGs, AT-4s, and Stingers. Proper training is required of all crewmembers to become efficient on all weapons. The range of possible threats warrants additional training, not only in weapon proficiency, but also against unconventional tactics. The U.S. Navy SEALs, who are trained in forcible boarding, search, and seizure of water vessels can teach counter

tactics. A properly trained and manned crew is a must to defend the ARSHIP from the surface and air threats.

4. Detection Equipment

To detect approaching threats, supplementary equipment may be needed. The addition of large sensor equipment systems such as active sonar may not be feasible. However, remotely operated cameras would assist in visual detection and isolation of threats. A single individual can monitor the camera system to observe the topside spaces, ship's sides, and the water adjacent to the ARSHIP. Forward looking infrared (FLIR) cameras and other forms of night vision technology are essential to help reduce the threat of night attack. Additionally, there must be a real time link to overhead sensors and companion vessels that may detect threats over the horizon from the ARSHIP to allow for proper warning.

5. Communications

Communications plays a key role in the effective employment of the ARSHIP. Some defensive options along these lines will be discussed under the section titled "deceptive options." One additional consideration beyond the automated communications system is the use of a phased array antenna built into the structure of the ship. More

conventional considerations have already taken into account link margin and protection of EHF SATCOM.

6. Deceptive Options

Other possible tactical defense options rely on deception. Similar in thought to the strategic use, the tactical use of deception will be to nullify the attack on the ARSHIP. The application of a visual form of camouflage, reminiscent of the paint schemes used on World War II warships, can be applied to the ARSHIP without altering the stealth properties gained through technology. Due to the dependence of special operations forces on visual identification, the paint schemes can aid in the ability of the ARSHIP to elude or deceive visual detection. The paint can camouflage the vessel with the surrounding sea or make it appear as another ship, such as a commercial or leisure vessel. To bolster the effects of deceptive paint, the use of false targets onboard the ARSHIP can be utilized.

Deceptive superstructure or equipment in conjunction with camouflage could effectively distract enemy fire from vital equipment and spaces. Dummy targets could include high profile antennas and communications equipment, superstructure for the operations of ship's maneuvering or crew berthing, and false weapon systems. Likewise, false

weapon systems on the deck to deceive an adversary could also deter a possible attack from special operations forces due to perceived self-defense capabilities. Again, the trade off between the technology of stealth and the possible radar signature of adding false structures to the ARSHIP must be evaluated.

7. *Inport* Defense

The ARSHIP is extremely vulnerable when *inport*. Defensive measures that can thwart the combat swimmer are fishing nets with audible or visible warnings, active sonar, active suctions and discharges, high speed currents, mammals, and active patrol boats. Each pose their own strengths and weaknesses. Nets in the water need to provide a barrier that the divers cannot sneak under or cut through without activating the warning devices. These nets will also need to be deployed and recovered every time the ARSHIP leaves and returns to port. The nets also must be maintained and checked often. The other options have been touched on in Section A of Chapter IV.

One additional method of defending against the combat swimmer operation is to utilize concussion grenades over the side of the ship to over-pressure the water and the semi-permeable cavities of the divers. This is effective, but only when the divers are near the ship. This use of

grenades excludes the use of trained mammals for swimmer defense.

D. SUMMARY

The ARSHIP will be engineered for stealth against electronic detection and classification. The proposed low cost tactical defensive measures are vital to the enhancement of its defense capabilities achieved through technology.

This thesis has proposed that the ARSHIP is most vulnerable during times of relative peace and at long distances from perceived threats. Chapter III proposed that the ARSHIP, due to its strategic importance in a conflict, is a prime target for preventative and preemptive attacks. Due to the ARSHIP's dependence on technological 'hiding' and not on defensive firepower, potential attackers must not be allowed to approach it within weapon release range. Of primary importance, is the ARSHIP's reliance on Joint Vision 2010's concept of *full dimensional protection*. Historically, the United States' military has been caught off guard, at home and abroad. This can be seen from the attack on Pearl Harbor, the Marine barracks in Beirut, and more recently, the Kobar Towers in Saudi Arabia. Special operations have the ability to strike

without warning and at long distances. The United States' opponents **will** utilize this option in the future.

Additionally, special operations will be utilized under conditions of singularity. When all other conventional attempts against the ARSHIP have failed or the means to face the ARSHIP conventionally are not available to the adversary, conventional operations will be ceased and give way to innovative special operations. These operations will be more clandestine, illusive, and most likely more successful. Their success will stem from the cognitive bias of the conventional naval warrior and the innovative spirit of the aggressor.

This thesis has shown the viability of possible unconventional threats that must be addressed in making the ARSHIP concept a successful reality. Any group or organization, which feels threatened by U.S. foreign policy and its implementation of the ARSHIP, may acquire the means to attack the ARSHIP via special operations. Conventional thinking, which dictates platform design and utilization, must adapt to a world in which unconventional threats to our most valuable military capabilities is becoming more predominant.

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